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BIRD MIGRATION WATCHES ON CROWN LEASE 17, ALBERTA, FALL 1984

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FOREWORD

Syncrude Canada Ltd. continues to conduct environmental research in the Athabasca Tar Sands region. The following report describes the patterns of bird migration over Syncrude's Lease area. This study is a follow-up to an earlier study conducted in 1975, prior to the start of Syncrude operations.

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BIRD MIGRATION WATCHES ON CROWN LEASE 17, ALBERTA, FALL 1984

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EXECUTIVE SUMMARY

Migration watches were conducted from 21 August to 15 October 1984 near the site of Syncrude Canada Ltd.'s bitumen mining, extraction and upgrading development north of Fort McMurray, Alberta. These watches were undertaken to complement studies of birds using the waterbodies in the area of the development.

Watches were conducted each morning and evening from a blind overlooking the Athabasca River valley. Morning watches began at first light and ended two hours after sunrise. Evening watches began two hours before sunset and lasted until it was too dark to see birds. In all, there were 49 morning watches and 51 evening watches. During each watch, migrating or potentially migrating birds were recorded. Birds making obviously local flights were not recorded. For each observation the following information was recorded: the time of the observation, number and species (or species group) of the birds seen, direction of flight, altitude, and distance from the blind at the point of closest approach. Non-systematic observations of swans, geese and cranes were also recorded during off-watch hours.

Comparison of data from migration watches in 1984 with data from 1975 (Ward et al. 1976) shows that patterns of migration over the study area have not changed appreciably. Both timing of migration and the diel pattern of passage were comparable in the two years for all species and species groups observed. Although large numbers of geese and lesser numbers of tundra swans and sandhill cranes passed over in both 1975 and 1980, few landed in the study area.

Waterfowl, cranes, gulls and ravens were the groups most commonly observed during migration watches. Small numbers of several hawk and eagle species were also seen but few of them appeared to be migrating.

Including observations both during watches and during off-watch hours, a total of 46 tundra swans were seen. All were flying in a generally southerly direction and most were between 75 m and 500 m above the Athabasca River. Swans appeared to pass over the area in two waves, one in the second week of

September and one in the second week of October. Few swans, however, landed in the study area.

Three species of geese, **greater white-fronted goose, snow goose** and **Canada goose** pass over the study area during migration but, like swans, few land. A total of 18,399 geese were observed: 6,157 were recorded during watches and 12,242 were recorded during off-watch hours. The Canada goose was by far the most abundant species and comprised 67.4% of the total. Snow geese and white-fronted geese comprised 3.5% and 5.2% of the total, respectively. The remainder of the geese recorded were not identified to species but the majority were probably Canada geese.

Geese were seen flying in all directions. However, over 80% of the geese seen were flying south through southwest, both during watches and during off-watch hours. Most geese were between 100 m and 300 m above the Athabasca River. Geese were seen fairly regularly until 2 October but the peak dates of migration were 30 August, 7 September and 25 September; the movement on 7 September alone accounted for 47% (8650 geese) of all the geese recorded. Each of these migration peaks followed the passage of a cold front through the study area, a situation consistent with observations of goose migration in other areas. The largest numbers of geese were seen during the second hour after sunrise, probably reflecting a dawn departure from the Peace-Athabasca Delta staging area.

Although large numbers of **ducks** were recorded during waterbody surveys in fall 1984 (McLaren and Smith 1985), relatively few were seen during migration watches. A total of only 440 ducks was recorded and some of these were probably engaged in local movements. Few ducks were identified to species. Two large flocks of ducks (170 and 66 birds) were, however, seen on two of the days when goose migration was highest. Moderate numbers of ducks also moved southwards on 13 and 14 October just before a major winter storm swept the area.

Many ducks migrating through the area may have remained undetected because they migrated at night. Daily counts of ducks on Horseshoe Lake, adjacent to the blind, support this hypothesis. Numbers of ducks on

Horseshoe Lake were consistently lower in the morning than in the evening, suggesting an overnight departure.

A total of 21 **sandhill cranes** were seen during watches and 132 cranes were seen during off-watch hours. Most were moving in a generally southerly direction at less than 100 m altitude. No cranes were seen after 18 September. Although **whooping cranes** have been recorded in the study area, none were seen during this study.

Although substantial numbers of **gulls** (6137 birds) were seen during migration watches, the majority were engaged in local movements to and from a roost on Mildred Lake. Gulls involved in these movements included ring-billed gulls. herring gulls and possibly California gulls but, because of the similarity of plumage of these three species, few were identified to species.

Gulls were first detected flying toward the roost on Mildred Lake on 6 September and substantial numbers were seen regularly from 14 September until the end of the study. Based on the maximum count during a watch, the roost was used by at least 617 gulls in late September. Observations suggest that many of these gulls probably followed the Athabasca River northwards before turning northwest toward the roost.

Although **ravens** are not strongly migratory, some do move southwards in winter. There was some suggestion of migration through the study area in 1984. We saw larger numbers in October (0.7 ravens/h of observation) than in August or September (0.2/h) and a larger proportion of the ravens seen were moving south or southwest than were moving in other directions.

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The field work was conducted by the senior author and by J. Barbeau of LGL Ltd. Assistance and guidance in planning, data analysis and report preparation were provided by W.J. Richardson of LGL Ltd. Personnel of RL & L Environmental Services, Hardy Associates (1978) Ltd., Bull Catering Ltd., Quasar Helicopters, and Syncrude Canada Ltd. reported flocks of geese passing during our "off-watch" hours. B. De Long prepared the figures; B. Griffen of LGL Ltd. typed the manuscript.

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1.0 INTRODUCTION

In 1974, Syncrude Canada Ltd. began construction of a bitumen mining, extraction and upgrading plant on Crown Lease 17, located about 40 km north of Fort McMurray, Alberta. Construction was completed in 1978 and the plant has been operating since that year.

The study area (Figure 1.1) includes the valley of the Athabasca River and the eastern portion of Lease 17. It is located about 180 km south of the Peace-Athabasca Delta, a major staging area for migrating waterfowl (Hennan 1973; Nieman and Dirschl 1973; Bellrose 1976; Palmer 1976) and lies within one of the areas delineated by Bellrose (1976) as waterfowl migration corridors. According to Bellrose (1976), 151,000 to 300,000 migrating geese and 751,000 to 1.5 million migrating ducks pass through the segment of northeastern Alberta that includes Lease 17. Several studies conducted on Lease 17 and in surrounding areas have confirmed that substantial numbers of migrating waterfowl both pass over the area and use waterbodies in the area as stopover locations during fall migration (Renewable Resources Consulting Services 1973; Schick and Ambrock 1974; Sharp et al. 1975; Sharp and Richardson 1976; Ward et al. 1976; McLaren and Smith 1985). The study reported here presents the results of migration watches conducted in autumn 1984. The study was designed to update existing information about the numbers of birds flying over the study area and to complement information about waterbird numbers on waterbodies on and near Lease 17 in 1984 (McLaren and Smith 1985).

2.0 METHODS

2.1 Data Collection

Migration watches were conducted from an observation post above the southwest arm of Horseshoe Lake along the Syncrude Lower Camp Road (Figure 1.1). The post was established approximately 1 km north of the location of the observation post used during migration watches in 1975 because that location is no longer accessible by road.

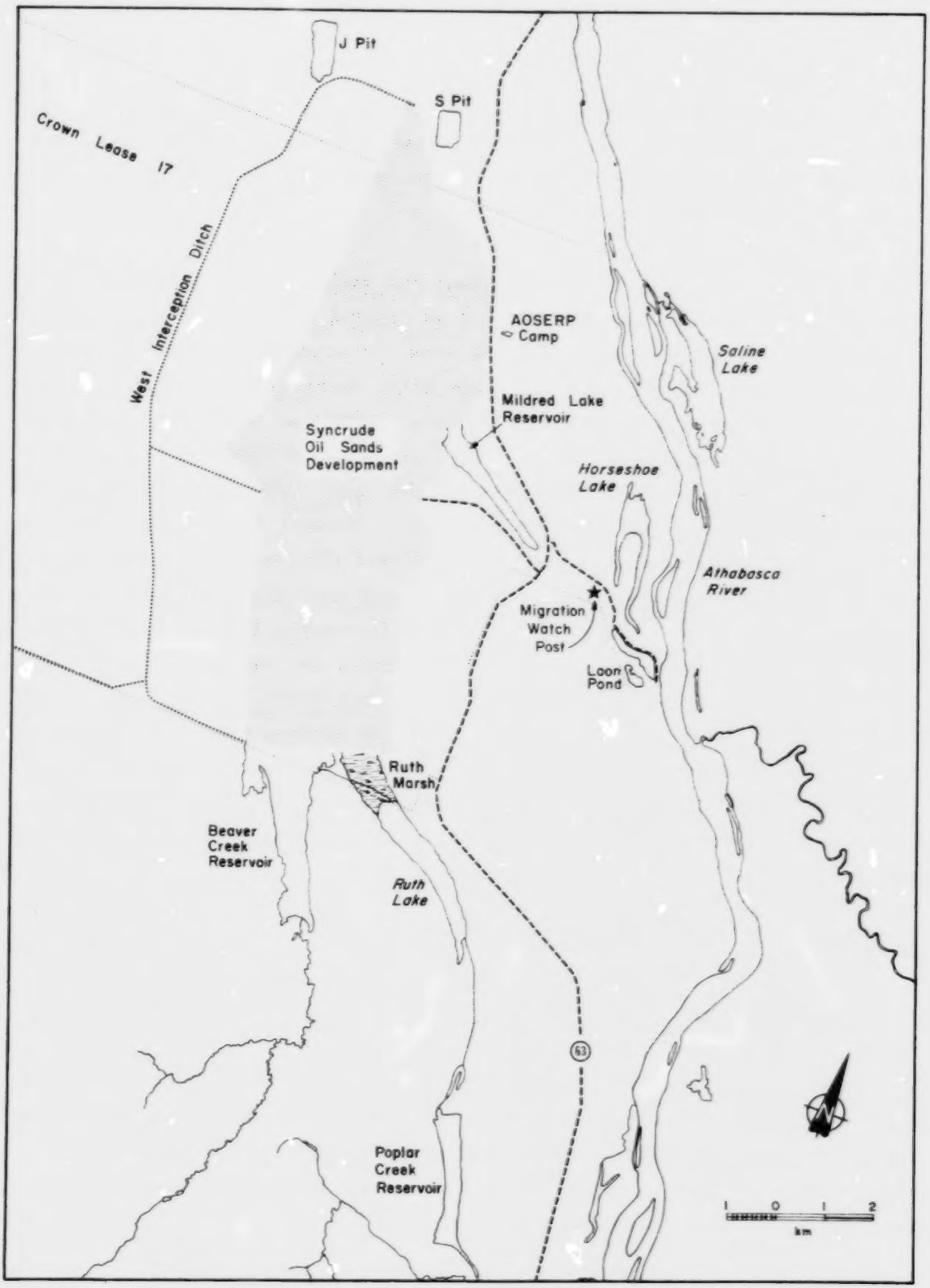

Figure 1.1. Map of the study area showing the location of the migration watch post.

The elevation of the observation post was about 60 m above that of the Athabasca River and overlooked the river valley from the west. Visibility was several kilometres to the north through east to southeast, but was restricted by trees and topography in other directions. With the exception of days when visibility was severely reduced by rain, watches were conducted each morning and evening from 21 August to 15 October 1984. There were no watches on 28 August or on 1 and 12 October. There were no morning watches on 21 and 29 August, and 3 and 4 September. There were no evening watches on 1 and 2 September. The morning watch began when there was enough light to detect flying birds against the sky and continued until two hours after sunrise. Evening watches began two hours before sunset and continued until it was too dark to see birds against the sky. A total of 253.0 h of migration watches were conducted. Table 2.1 gives the numbers of hours of watch relative to sunrise and sunset. Watches were conducted near sunrise and sunset because peaks in migratory movement tend to occur at these times (e.g., Richardson 1970).

During watches the observer scanned above and below the horizon with binoculars at regular intervals. A telescope was also used to aid in identification. Records of bird observations were made directly onto a data form for all birds whose flight behaviour suggested that they might be migrating. Birds in this category included all those that flew by the blind in level flight as well as birds seen landing from or taking off into level flight above tree-top level. Many birds that were actually engaged in local flights were undoubtedly recorded and the probability of migration or local flight is discussed below for each species. Birds that were engaged in flights that were obviously local (e.g., ducks flying low over Horseshoe Lake, passerine flocks flitting through the trees) were not recorded on the data forms. However, records were kept of the species and approximate numbers of small birds seen in the vicinity of the blind during each watch, and the number of waterbirds visible on the northern part of Horseshoe Lake were counted during each watch. However, it was rarely possible to identify these birds.

For each observation of potentially migrating birds, the following data were recorded: the date, time of observation, species or species group, total number of birds, flight direction, altitude of the birds (above the Athabasca

Table 2.1. Numbers of hours of migration watches conducted from an observation post on Syncrude's Lower Camp road, Crown Lease 17, Alberta, 21 August-15 October 1984.

	Hours of Observation	
	Morning Watch	Evening Watch
Before sunrise	24.9	-
0-1 h after sunrise	49.0	-
1-2 h after sunrise	47.6	-
1-2 h before sunset	-	50.5
0-1 h before sunset	-	51.0
After sunset	-	30.1

detected, the distance of the birds from the blind at their point of closest approach, the direction of the birds from the blind at their closest approach, behaviour, and, when appropriate, habitat. When possible, the sex and age class of birds seen were also recorded. In addition to information about the birds, a number of time and weather variables were also recorded. These included start and end times of the watch, temperature, wind speed and direction, cloud opacity (in tenths), visibility, and type and extent of precipitation.

Additional non-systematic information about migrating swans, geese and sandhill cranes was obtained during off-watch hours. All flocks seen by or reported to the observer were recorded and, whenever possible, the flight direction and altitude of these birds were recorded.

2.2 Data Analysis

The data were transferred manually to summary sheets by species or species group (e.g., goose sp.). The data summaries were then entered on a computer for further sorting and analysis.

The results of migration watch counts are generally expressed as numbers of birds of each species or group seen flying by the blind during each day. This procedure may have biased the results on the six days with only one watch (see above). The volume of migration could be underestimated for these days if substantial numbers of a particular species were flying during the time of day with no watch. This is unlikely since days with only one watch were those with heavy rain (five days) or fog (one day) in the morning or evening. Birds tend not to migrate in rain (Richardson 1978). It is more likely that daily migration volume was overestimated on days with only one watch. Correspondingly, the overall average migration volume was probably unbiased or at most slightly overestimated by use of the total number of birds as the base of comparison. Total hours of watch were 253.0 h. Hours of watch for each day are given in Appendix 1.

In the tables and figures showing volume of migration relative to sunrise and sunset, rates of migration are based on the numbers of hours of watch in the period under consideration. The nonparametric chi-square test or Wilcoxon matched-pairs signed-ranks test was used to compare numbers of birds seen at various times of day or at various altitudes. Tests were conducted on number of flocks since flocks rather than individuals represent independent units of observation.

Comparisons are made in this report with the results of migration watches conducted in 1975 (Ward et al. 1976). In 1975, watches were conducted from two posts, an eastern post located about 1 km south of the post used in 1984 and a western post located near the western boundary of Lease 17. Watches were also conducted in spring and summer in 1975. 'Fall' watches in 1975 were considered to include 16 August to 31 October. For purposes of comparison with 1984, however, only observations from the eastern post during the same period in which watches were conducted in 1984 are considered. A total of 326 h of watches were conducted at the eastern post from 21 August to 15 October 1975. In 1975, substantial movements of some birds occurred after 15 October. When such movements did occur, they are discussed.

2.3 Limitations and Biases

Migration watch counts can provide useful indices of volume of migration for some species of birds but the limitations of the method must be recognized. Migration watches conducted in daylight give no information about nocturnal migrants (e.g., most passerine species, many shorebirds and waterfowl) and migration watches conducted only near sunrise and sunset give no information about migration through the day. This problem was partly overcome by recording off-watch sightings of migrants for the major species (swans, geese and cranes). These records showed that substantial migration did occur during midday.

Within the watch periods, numbers of birds detected may be biased by inter-observer variability in detection rates (Enemar 1964; Källender and Rydén 1974) and by differing behaviour of the birds. Inter-observer differences in ability to detect birds should not have a marked effect on this study. Only two observers were used and the same observer conducted all watches except those from the evening of 21 September through the evening of 25 September.

Detection rates do differ among species but are probably more similar within species groups (e.g., ducks, geese) than between species groups. Major factors affecting detectability include size of the birds, tendency to fly in flocks (and size of flocks), tendency to fly at high or low altitudes and tendency to call while in flight. Geese, for example, are large birds that fly in flocks and frequently call while in flight. They are, thus, more likely to be detected and to be detected at longer distances than ducks which are smaller, often fly singly and rarely call in flight. Geese and ducks are both more detectable than shorebirds, which often fly too high to be seen. The relative detectabilities of different species are not known and, therefore, numerical comparisons of volume of migration should not be made between species.

3.0 SPECIES ACCOUNTS

The following sections describe and discuss the flight movements of all birds detected during migration watches. The information is presented by species except in cases when very few individuals were identified to species level. In these cases the few identified individuals are discussed in a general species-group discussion.

3.1 Tundra Swan (Cygnus columbianus)

Tundra swans nest in arctic areas in Canada and Alaska. They are transients in northeastern Alberta (Salt and Salt 1976).

A total of 14 tundra swans in three flocks were seen during migration watches; 32 swans were seen during off-watch hours. All of the tundra swans seen were flying southeast, south or south-southwest and most were between 75 m and 500 m in altitude. The only exception was a family group that took off from Horseshoe Lake.

Although the data are sparse, it appears that tundra swans migrated in two waves, the first during the second week of September and the second in about the second week of October (Table 3.1). T. Barry (in Bellrose 1976) indicates that the major movement of swans from northern nesting areas to migration stopover sites in the Northwest Territories and northern Alberta (mainly the Peace-Athabasca Delta) does not occur until late September. Nevertheless, swans were also seen during migration watches in 1975 in mid September, although most of the migration in 1975 was, as in 1984, during the first half of October (Ward et al. 1976). Possibly these early migrants are immature birds or birds whose nesting attempt was unsuccessful. Swans usually migrate in family groups (Bellrose 1976; Palmer 1976) and at least one of the groups seen in October in 1984 contained two young swans.

A considerably larger number of swans were seen during fall migration studies in 1975 than were seen in 1984 (610 vs. 46). The reason for this is unknown. The wintering area of these swans is along the east coast of the U.S.A., so there is a strong eastward component to their migration. Most

Table 3.1. Characteristics of tundra swan flocks observed passing over the study area, 21 August-15 October 1984.

	No. of Birds	On or Off Watch	Flight Direction	Altitude (m)
7 September	6	off	SSW	300
12 September	7	on	SE	75
16 September	+[a]	on	-[b]	-
6 October	10	off	SE	150
6 October	11	off	SE	150
7 October	4	off	-	-
8 October	1	off	-	-
11 October	2	on	SSW	500
13 October	5	on	S	1[c]

[a] Swans were heard flying over but not seen.
[b] Unknown.
[c] Flushed from Horseshoe Lake.

swans leaving the Peace-Athabasca Delta do so to the southeast, whereas a smaller number leave to the south (Bellrose 1976). The study area is located south of the delta and a small shift in the migration corridor used by swans could result in fewer swans passing over. Also, swans commonly migrate at night (Palmer 1976); those leaving the Peace-Athabasca Delta around sunset would not have been seen during this study.

Regardless of the numbers of swans overflying the study area, few appear to land. Schick and Ambrock (1974) reported 'several thousand' swans on or near the study area in fall 1972 but gave no details about precisely where these birds were or how long they stayed. Renewable Resources Consulting Services (1973) also surveyed the study area in fall 1972 but reported few swans. Similarly, few swans were seen on the water or ground in the study area during fall migration in 1971, 1973, 1974, 1975 or 1984 (Renewable Resources Consulting Services 1973; Schick and Ambrock 1974; Sharp et al. 1975; Sharp and Richardson 1976; McLaren and Smith 1985).

3.2 Geese

Four species of geese occur in the study area. They are the greater white-fronted goose, snow goose, Ross' goose and Canada goose (Bellrose 1976). Canada geese are uncommon nesters in the study area, but migrate through in large numbers. The other three occur only as transients. Ross' goose (Chen rossii) is less abundant than the other species; most Ross' geese leave to the southeast from their Peace-Athabasca Delta staging area, rather than south in the direction of the Syncrude development. No Ross' geese were identified during migration watches in 1984.

The goose species that occur in the study area can be identified by both sight and sound. However, many geese were detected at long distances from the blind and visual identification of these birds was often impossible. Species identification was made if the geese were calling but otherwise they were recorded as unidentified geese. In total, 40.9% of the geese observed during watches were not identified to species. These geese are discussed in the section on 'All Geese'.

3.2.1 Greater White-fronted Goose (Anser albifrons)

The white-fronted geese that migrate through the study area nest primarily in the Mackenzie Delta and westwards along the coast of the Yukon and Alaska (Bellrose 1976). Geese from these areas fly to a staging area in southern Alberta and southern Saskatchewan. The main migration corridor to this staging area is somewhat west of the study area (Bellrose 1976).

During migration watches in 1984, a total of 401 white-fronted geese (1.6/h) in 12 flocks were counted. Three other flocks were heard flying over but were above or in clouds or fog and could not be seen. During off-watch hours, 558 white-fronted geese in 11 flocks were seen (Table 3.2). The largest flock observed was 70 birds and overall flock size averaged 41.7 birds. Figure 3.1 shows the distribution of flock sizes observed during migration watches.

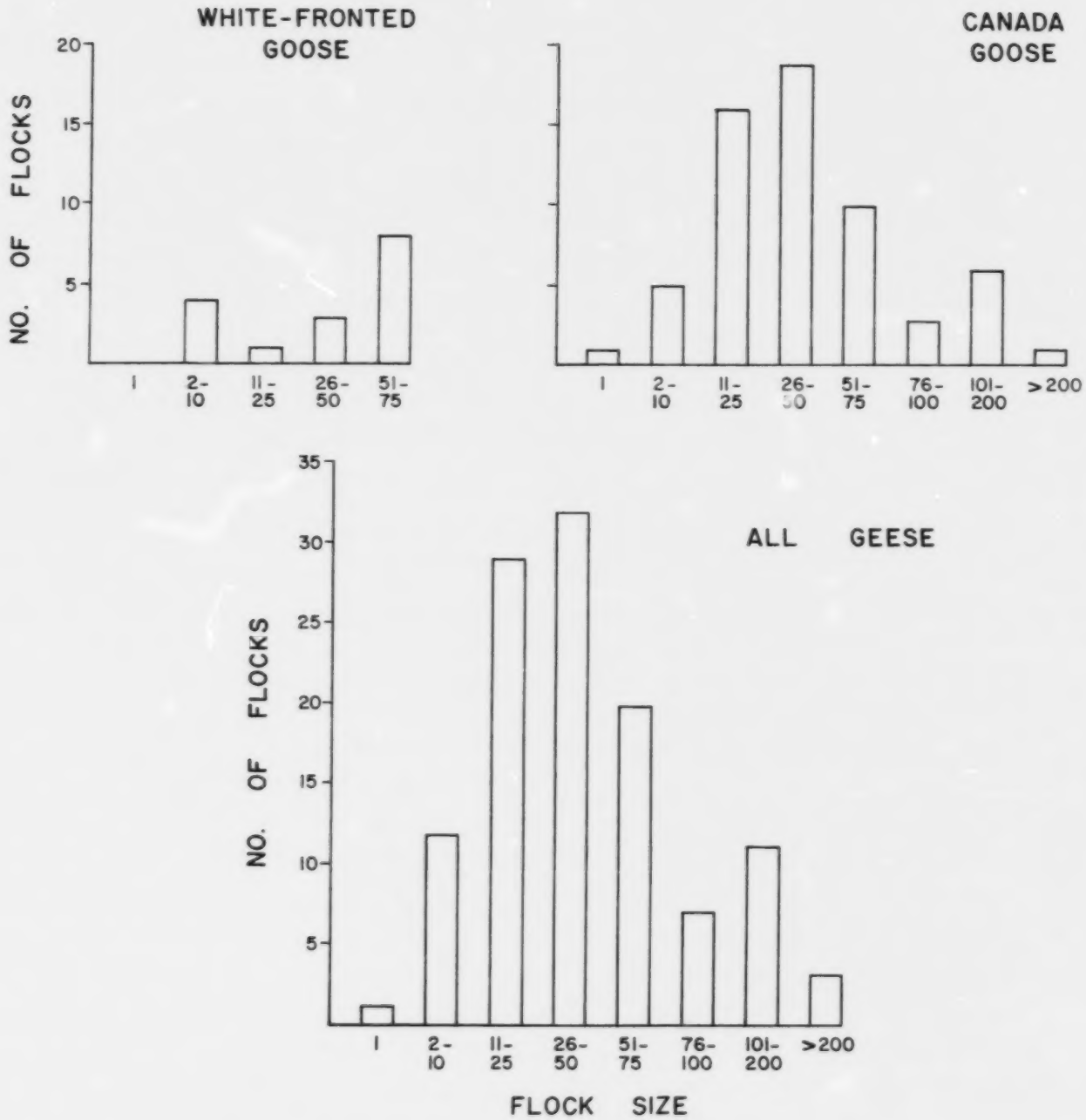

Figure 3.1. Distribution of flock sizes for white-fronted geese, Canada geese and all geese seen during migration watches.

Table 3.2. Numbers of geese seen during migration watches and during off-watch periods in the study area, 21 August-15 October 1984.

Species	During Watches		Off-watch Observations	
	#	%	#	%
White-fronted goose				
Flocks	15	12.1	11	7.1
Birds	401	6.5	558	4.6
Snow goose				
Flocks	5	4.0	9	5.8
Birds	220[a]	3.6	432	3.5
Canada goose				
Flocks	65	52.4	115	74.7
Birds	3016[a]	49.0	9380	76.6
Unidentified geese				
Flocks	39	31.5	19	12.3
Birds	2520[a]	40.9	1872	15.3
Total				
Flocks	124		154	
Birds	6157[a]		12,242	

[a] Totals do not include flocks heard above or in clouds.

White-fronted geese were first seen on 29 August 1984 and last seen on 23 September. The largest numbers of white-fronted geese moved through the area on 8-10 September and 14-15 September (Figure 3.2). None were seen before sunrise and only one flock was seen after sunset (Figure 3.3, Table 3.3).

Most white-fronted geese seen during migration watches were flying south, southwest or west-southwest (Table 3.4, Figure 3.4). However, flocks seen during off-watch hours tended to be flying more to the east. Over 80% of the birds seen during off-watch hours were flying between south and southeast (Table 3.5). All of the white-fronted geese seen were flying less than 300 m above the Athabasca River with most at 200-300 m above the river (Table 3.6, Figure 3.5).

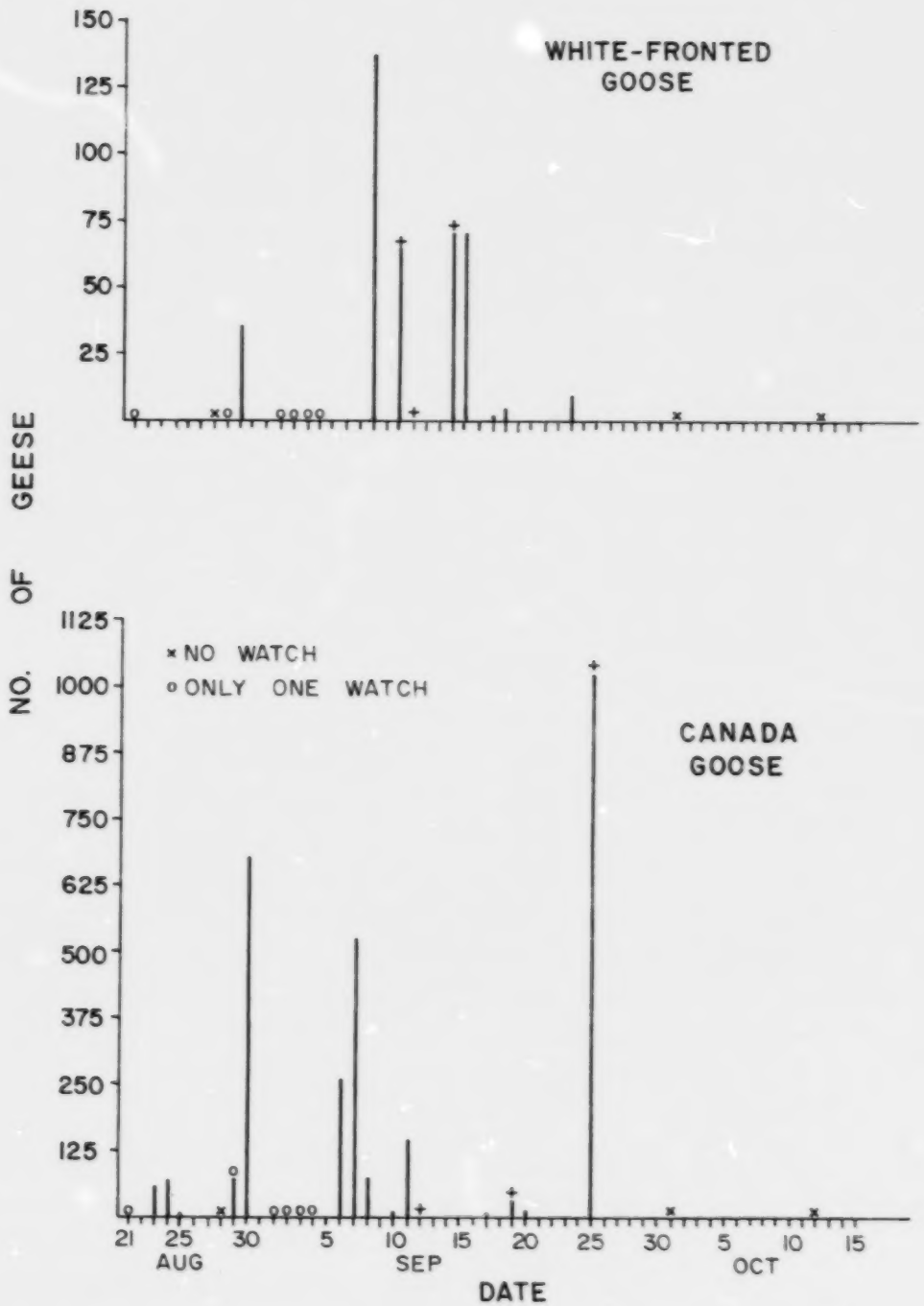

Figure 3.2. Daily volume of migration of white-fronted geese and Canada geese past the migration watch post.

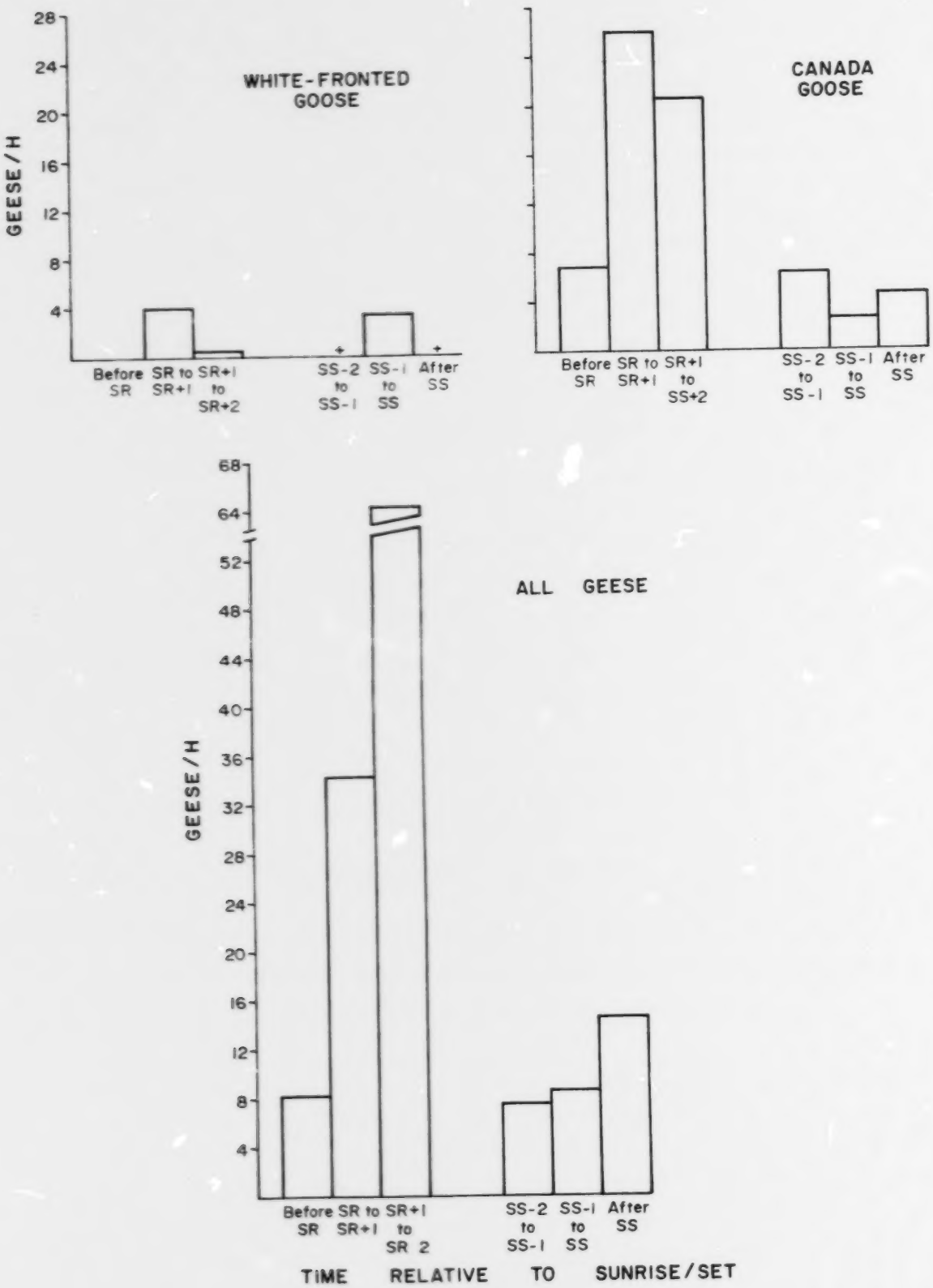

Figure 3.3. Volume of migration of white-fronted geese, Canada geese and all geese at various times of day (relative to sunrise and sunset).

Table 3.3. Numbers of geese seen relative to sunrise and sunset during migration watches in the study area, 21 August-15 October 1984.

Species	Morning				Evening			
	Before SR[a]	SR to SR + 1	SR + 1 to SR + 2	Total[c]	SS - 2 to SS - 1	SS - 1 to SS	After SS	Total[c]
White-fronted goose								
Geese	0	196	30	226	+[b]	175	+	175
Flocks	0	6	3	9	1	4	1	6
Geese/h	0.0	4.0	0.6	1.9	+	3.4	+	1.3
Snow Goose								
Geese	0	0	20	20	75+	0	125	200+
Flocks	0	0	1	1	3	0	1	4
Geese/h	0.0	0.0	0.4	0.2	1.5+	0.0	4.5	1.5+
Canada Goose								
Geese	170+	1275+	982	2427	312+	140	137	589
Flocks	7	21	23	51	6	5	3	14
Geese/h	6.8+	26.0+	20.6	20.0	6.2+	2.7	4.5	4.5
Unidentified Goose								
Geese	37	208	2019	2264	0	106	150	256
Flocks	2	4	30	36	0	2	1	3
Geese/h	1.5	4.2	42.4	18.6	0.0	2.1	5.0	1.9
All Geese								
Geese	207	1679	3051	4937	387	421	412	1220
Flocks	9	31	57	97	10	11	6	27
Geese/h	8.3	34.3	64.1	40.6	7.7	8.3	13.7	9.3

[a] SR = sunrise, SS = sunset.

[b] Geese of this species were heard passing over but the flock was in the clouds and could not be seen.

[c] Totals for 'geese/h' are the overall values for the morning or evening watch.

Table 3.4. Flight directions of geese observed during migration watches in the study area, 21 August-15 October 1984.

Species	Geese/h									
	N	E	SE	SSE	S	SSW	SW	WSW	W	NW
White-fronted goose	0.0	<0.1	0.0	0.0	0.8	0.0	0.5	0.3	0.0	0.0
Snow goose	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0
Canada goose	0.0	0.2	0.0	0.5	5.3	2.5	2.7	0.6	0.0	<0.1
Unidentified geese	<0.1	0.0	1.1	0.4	1.3	0.4	6.1	0.0	0.8	0.0
All geese	<0.1	0.2	1.1	0.9	8.2	2.9	9.3	0.9	0.8	<0.1

A somewhat larger number of white-fronted geese (603 birds) was seen during migration watches in fall 1975 than during fall 1984 and white-fronted geese were apparently present in the area somewhat later. Although they were last seen on 29 September during watches in 1975, they were recorded during off-watch times throughout October 1975. The last sighting of white-fronted geese in 1975 occurred on 25 October (Ward et al. 1976). This is a very late date--Bellrose (1976) indicates that white-fronted geese have usually left their southern Alberta staging area by mid October.

3.2.2 Snow Goose (Chen caerulescens)

Snow geese from a number of arctic nesting colonies stage in fall at the Peace-Athabasca Delta before continuing south to other staging areas in southeastern Alberta and southwestern Saskatchewan (Bellrose 1976).

Only five flocks of snow geese were recorded during migration watches in 1984. Two of these flocks were heard only; they were above or in the clouds. The remaining three flocks ranged in size from 20 to 125 birds and totalled 220 birds (0.9/h). During off-watch hours we saw a total of 432 snow geese in nine flocks The largest flock seen contained 175 geese.

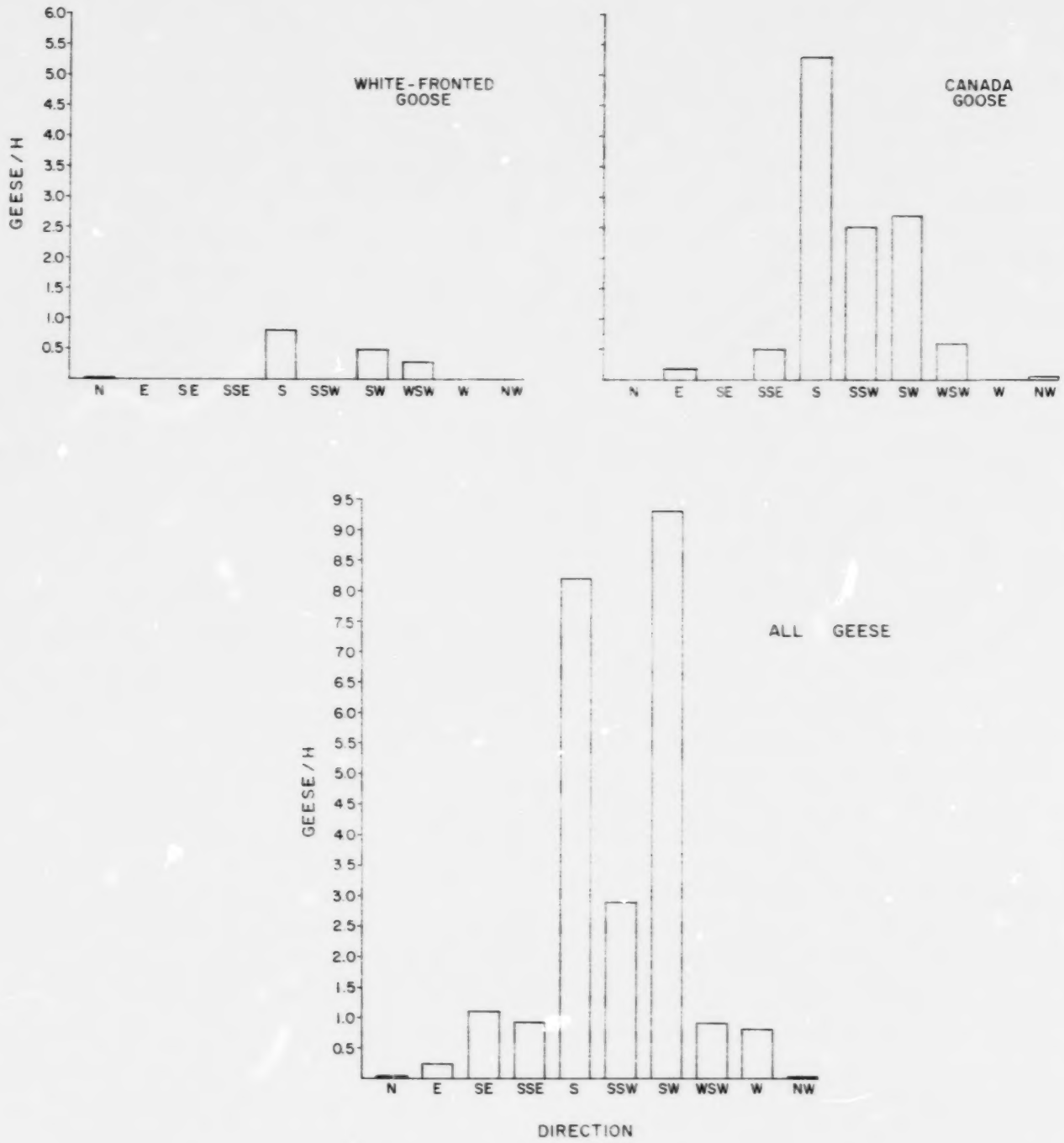

Figure 3.4. Volume of migration in each direction that any geese flew for white-fronted geese, Canada geese and all geese.

Table 3.5. Flight directions of geese seen in the study area during off-watch hours, 21 August-15 October 1984.

Species	Direction																	
	E		SE		SSE		S		SSW		SW		WSW		W		NW	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
White-fronted goose	–	–	142	25.4	166	29.7	150	26.9	–	–	100	17.9	–	–	–	–	–	–
Snow goose	–	–	–	–	–	–	396	97.5	10	2.5	–	–	–	–	–	–	–	–
Canada goose	7	0.1	390	4.2	526	5.6	4917	52.5	2011	21.5	659	7.0	408	4.4	348	3.7	100	1.1
Unidentified geese	–	–	76	4.5	–	–	808	47.9	602	35.7	200	11.9	–	–	–	–	–	–
All geese	7	0.1	608	5.0	692	5.8	6271	52.2	2623	21.8	959	8.0	408	3.4	348	2.9	100	0.8

Snow geese were seen between 7 September and 2 October 1984. Four of the five flocks detected during migration watches flew over during the evening watch (Table 3.3) and all snow geese recorded, both during watches and during off-watch hours were flying south or south-southwest (Tables 3.4 and 3.5). Snow geese were seen at altitudes ranging from 300 m to over 1000 m (Table 3.6).

Table 3.6. Altitudes of geese observed during migration watches in the study area, 21 August-15 October 1984.

Species	Geese/h								
	0-[a] 50	51-100	101-150	151-200	201-300	301-400	401-500	501 1000	>1000
White-fronted goose	<0.1	0.3	0.4	0.0	0.8	0.0	0.0	0.0	0.0
Snow goose	0.0	0.0	0.0	0.0	0.1	0.0	0.3	0.0	0.5
Canada goose	0.1	0.8	2.3	4.7	3.3	0.0	0.3	0.1	0.3
Unidentified goose	0.0	<0.1	1.1	0.5	7.9	0.0	0.0	0.0	0.4
All geese	0.1	1.2	3.8	5.2	12.2	0.0	0.6	0.1	1.2

[a] Metres above the Athabasca River.

About three times as many snow geese were seen in 1975 (627 geese) as were seen in 1984 (Ward et al. 1976). Migration apparently began about a week earlier in 1984 than in 1975 but flight direction and altitude were similar in the two years.

3.2.3 Canada Goose (Branta canadensis)

The Canada geese that migrate over the study area are members of the Shortgrass Prairie population that nests in the central Northwest Territories (Bellrose 1976). These geese fly southwards on a broad front across Saskatchewan and Alberta to wintering areas in the central and southern United States.

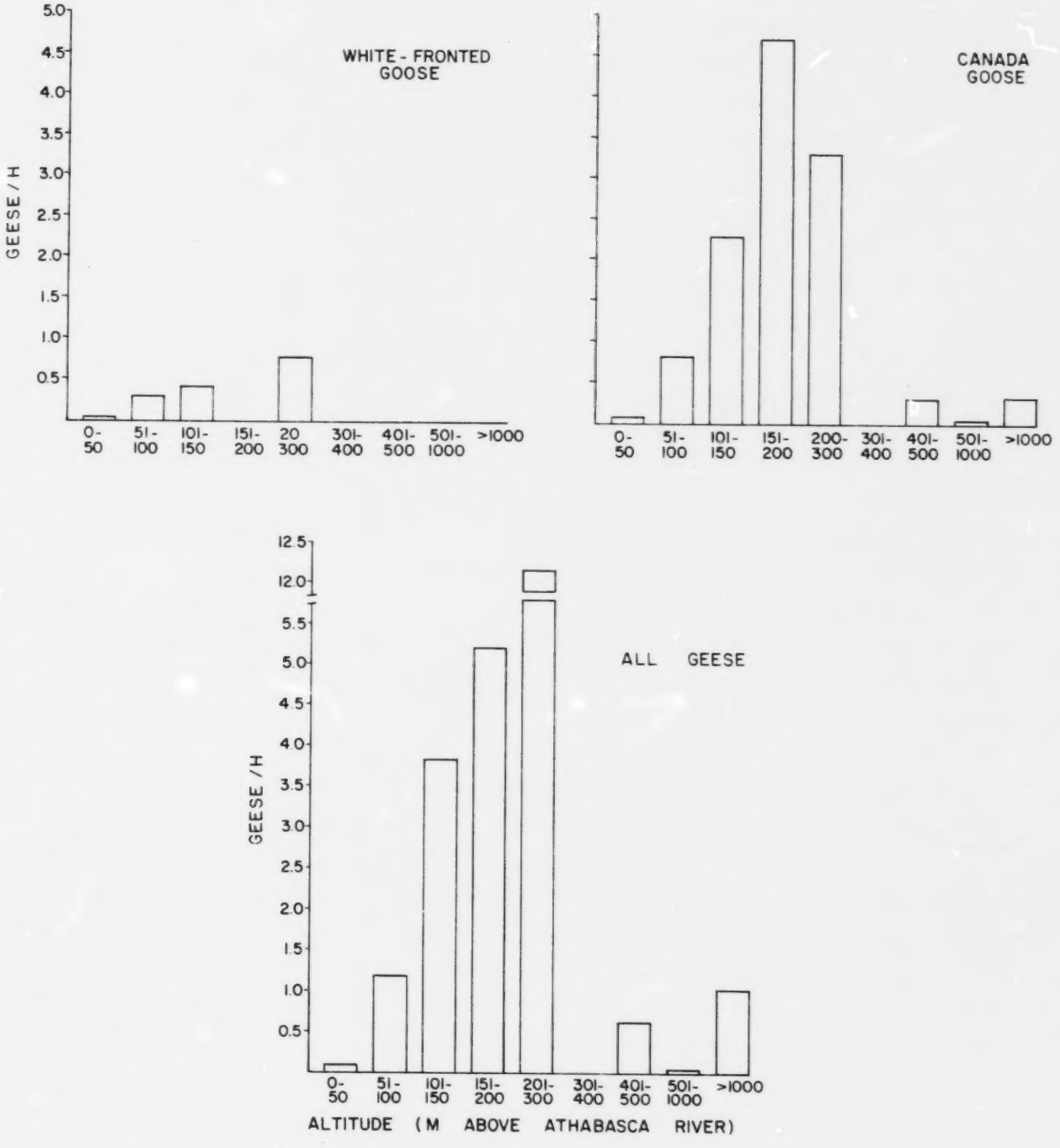

Figure 3.5. Altitudinal distribution of white-fronted geese, Canada geese and all geese recorded during migration watches.

Canada geese were by far the most numerous geese recorded during fall migration in 1984. A total of 3016 Canada geese (11.9/h) in 61 flocks were recorded during migration watches; four flocks were flying over or in the clouds. An additional 9380 Canada geese in 115 flocks were recorded during off-watch hours. Flock sizes ranged from 1 to 1080 geese and averaged 70.4 geese. Figure 3.1 shows the frequency distribution of flock sizes for flocks observed during watches.

Migrating Canada geese were seen during migration watches between 23 August and 25 September. The last Canada goose seen during the study was a single individual seen on the west bank of the Athabasca River on 28 September. Peaks of Canada goose migration occurred on 29-31 August, 6 September to about 11 September and 24-25 September (Figures 3.2, 3.6). Most of the geese seen during watches flew over during the morning watch (average of 20.0/h vs. 4.5/h in the evening, Table 3.3). However, this difference was not statistically significant (Wilcoxon matched-pairs signed-ranks test, $T = 27$, $N = 15$, $P>0.05$). In the morning, by far the largest number of Canada geese were seen after sunrise (Figure 3.3, Table 3.3). In the evening most Canada geese were seen 1-2 h before sunset. However, moderate numbers of Canada geese continued to migrate until and after sunset (see also 'All Geese' below).

No Canada geese were seen travelling north or northeast but at least a few geese flew in most other directions from east through northwest (Tables 3.4, 3.5, Figure 3.4). Nevertheless, over 80% of the Canada geese seen both during watches and during off-watch hours were flying south, south-southwest or southwest, and the largest number were flying due south (5.3/h during watches and 52% of the birds seen during off-watch hours). Canada geese were seen at estimated altitudes varying from 50 m to 2500 m but the large majority were seen between 101 and 300 m (Table 3.6, Figure 3.5). The two flocks estimated to be flying at 2500 m were near the upper limit of the known migration altitude for Canada geese (Bellrose 1976) and would not likely have been detected if the geese had not been calling.

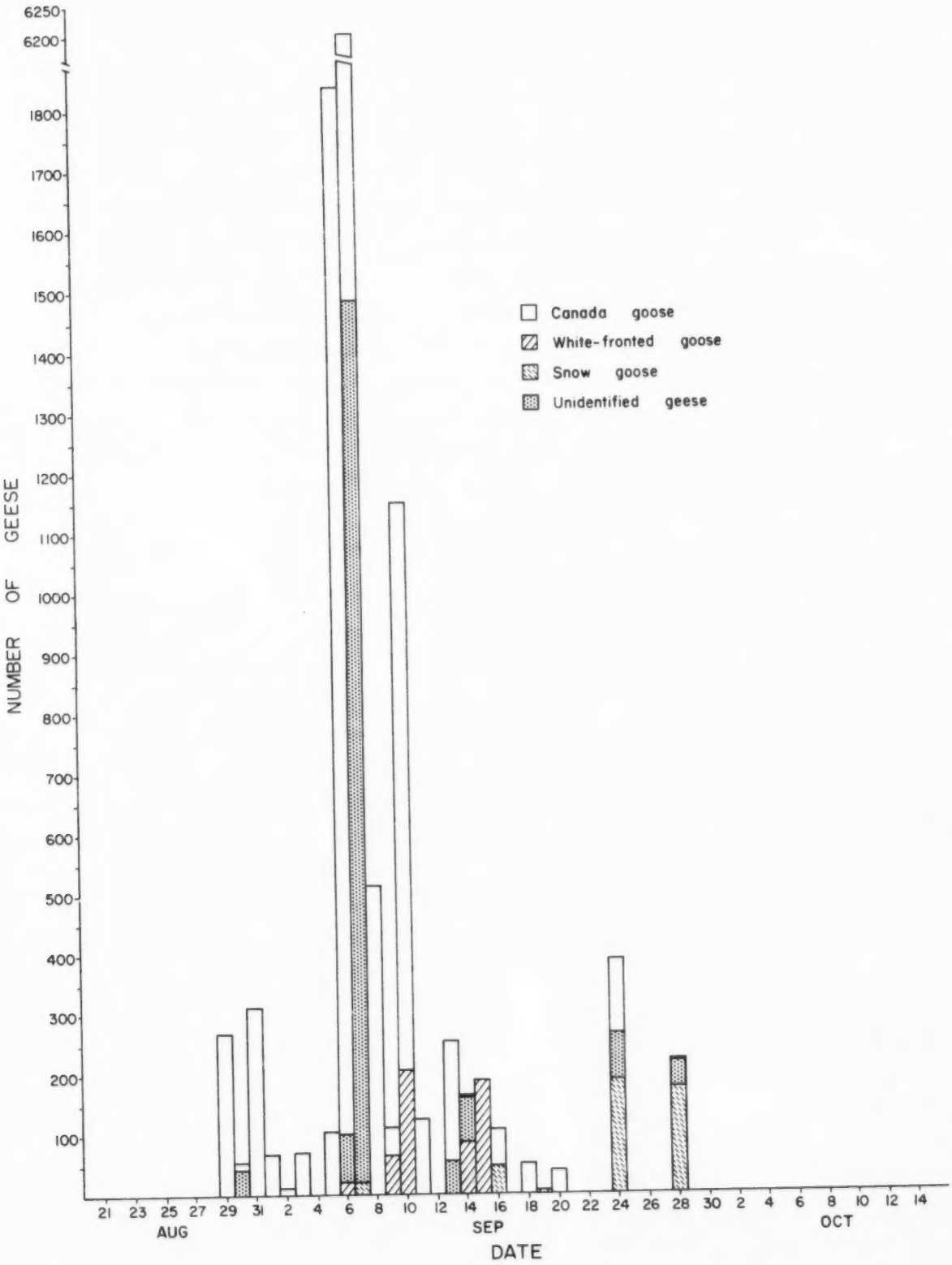

Figure 3.6. Numbers of geese of each species seen during off-watch hours.

Over twice as many Canada geese were seen migrating over the study area in 1984 as were seen in 1975 (Table 3.7). Numbers seen per hour of watch were also about twice as high in 1984 (11.9 vs. 6.2 in 1975). However, the distribution of sightings within watch periods was generally similar in the two years. In both 1975 and 1984, more Canada geese were seen in the morning than in the evening and numbers decreased over the course of evening watches (cf. Ward et al. 1976, Figure 14). As in 1984, most Canada goose migration in 1975 occurred between late August and late September. However, in 1975 flocks totalling 235 Canada geese were seen migrating through the study area on 23-24 October (Ward et al. 1976). In 1984, the study ended on 15 October and later movements of geese would not have been detected.

Table 3.7. Numbers of geese seen migrating over and near the study area, 21 August-15 October 1975 and 1984.

Species	No. of Geese Seen					
	1975[a]			1984		
	Watch Hours (326 h)	Off-watch Hours	Total	Watch Hours (253 h)	Off-watch Hours	Total
White-fronted goose	603	907	1510	401	558	959
Snow goose	752	1157	1909	220	432	652
Canada goose	2021	3800	5821	3016	9380	12,396
Unidentified geese	2256	548	2804	2520	1872	4392
All geese	5632	6412	12,044	6157	12,242	18,399

[a] Data for 1975 from Ward et al. (1976).

3.2.4 All Geese

A total of 18,399 geese were observed migrating over the study area in fall 1984; 6157 geese (24.3/h) were recorded during migration watches and 12,242 geese were recorded during off-watch hours. About 24% of the total and 41% of the geese seen during migration watches consisted of geese that

were not identified to species (Table 3.2). It is very likely that the majority of these were Canada geese. Geese were seen in flocks ranging in size from one individual to 1080 individuals. The average flock size, considering all observations, was 66.2 geese. The average flock size seen during watches was 49.7 geese. The distribution of flock sizes seen during watches is shown in Figure 3.1.

The peak days of goose migration were 30 August, 7 September and 25 September, with the largest movement occurring on 7 September (Figures 3.6 and 3.7). On that date, we recorded 8650 geese, including both geese recorded during migration watches and during off-watch hours. This figure represents 47% of the total seen from 21 August to 15 October. Geese migrated at all times of day but much larger numbers were seen during morning watches (40.7/h) than during evening watches (9.3/h). Within the morning period, relatively few geese were seen before sunrise and the largest numbers (64.2/h) were seen 1-2 h after sunrise. In the evening, more geese were seen after sunset than during either of the two hours before sunset (Table 3.3, Figure 3.3).

Geese were seen flying in all directions but by far the largest numbers were headed south through southwest. This was true for both geese seen during watches (20.4/h, 83.8% of the total, Figure 3.4, Table 3.4), and also for geese seen during off-watch hours (82.0%, Table 3.5). Geese were seen at estimated altitudes varying from 30 m to 2500 m but most were between 101 and 300 m above the elevation of the Athabasca River (Table 3.6, Figure 3.5).

3.2.5 Discussion

Geese tend to migrate in largest numbers with moderate following winds and falling temperatures, conditions that occur following the passage of a cold front, on the west side of areas of low barometric pressure (see review by Richardson 1978). During this study, cold fronts passed through the area on 29 August, 6 September, 24 September and 12 October. Although goose migration had apparently concluded before the last date, a major movement of geese followed each of the other cold fronts. From 27-29 August, north-eastern Alberta was under the influence of a low pressure system that brought

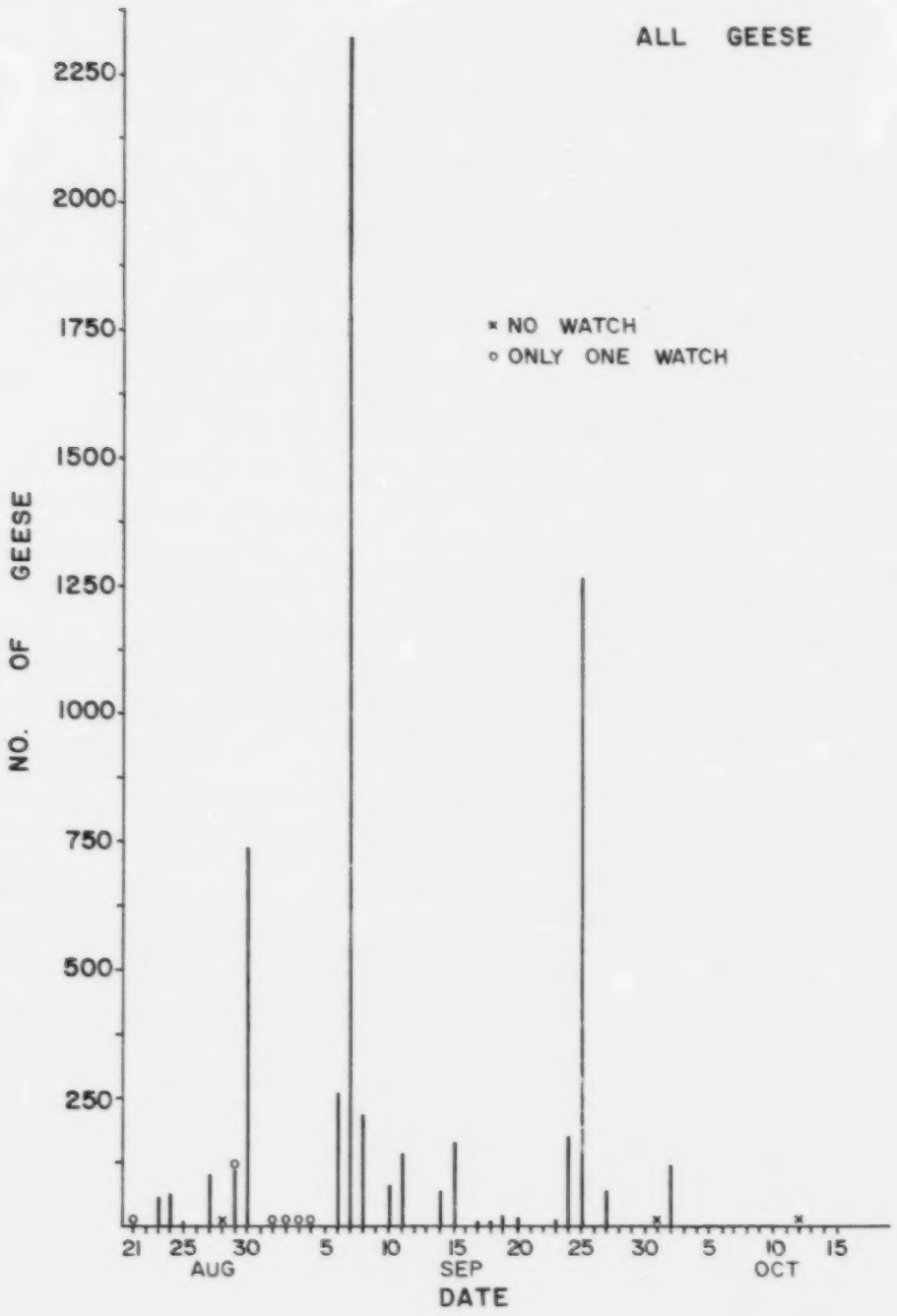

Figure 3.7. Daily volume of migration of geese of all species past the migration watch post.

heavy rain. With the end of the rain in mid morning on 29 August, and a northwest wind, geese began moving southward. The main movement occurred the following day with a moderate westerly wind. Small numbers of geese continued to pass over the study area during the next several days, although none were seen during migration watches.

After another period of cloud and some rain on 5 September, the temperature dropped and the wind became northerly at about 5 km/h on the morning of 6 September. The first goose flocks were seen about noon on 6 September. By evening the wind had strengthened to over 40 km/h and shifted to the northeast. Geese continued to migrate in spite of the strong winds and, as mentioned above, very large numbers passed through on 7 September. Small to moderate numbers of geese continued to pass over the study area each day until 20 September when northeastern Alberta came under the influence of another low pressure system. This system brought rain, snow and generally easterly winds; no geese were seen on 21 or 22 September. A few geese were seen on 23 and 24 September despite unfavourable winds, but the last major movement of geese through the area occurred on 25 September with moderate (5-10 km/h) north to northeast winds.

Although geese do migrate by both day and night (Bellrose 1976; Wege and Raveling 1983), the relative scarcity of observations before sunrise in this study suggests that most geese took off in daylight. All three species of geese stage in large numbers at the Peace-Athabasca Delta (Nieman and Dirschl 1973; Bellrose 1976). If birds began to leave the delta at first light and flew at a speed of 80 km/h (cf. Bellrose 1976), they would have begun to cross the study area beginning about 0.5 h after sunrise. The somewhat higher numbers seen after sunset than in the hours immediately before sunset may represent the passage of geese departing the delta in late afternoon and intending to fly through the night.

Over 50% more geese were seen in 1984 than in 1975 (Table 3.7). Numbers of white-fronted and snow geese were smaller in 1984 but over twice as many Canada geese were seen in 1984 than in 1975. Although more geese were seen in 1984, the pattern of migration was generally quite similar to that seen in 1975. In 1975, peak migration occurred on only a few days and most geese

passed through the area between 24 August and 29 September. As in 1984, numbers of geese passing were greater in the period 1-2 h after sunrise than they were earlier. Numbers were generally lower in the evening than in the morning but increased after sunset. In neither year did large numbers of geese land on the study area (Sharp and Richardson 1976; McLaren and Smith 1984).

3.3 Ducks

About 18 species of ducks are likely to occur in northeastern Alberta during autumn migration. A total of 440 ducks (1.7/h) were seen during migration watches in 1984. Most ducks seen in 1984 could not be identified to species. Three (0.7%) were identified as mallards and 29 (4.5%) were identified as teal. The remainder were identified only as ducks.

Ducks were seen in flock sizes ranging from one to 170 but only two flocks larger than 50 were seen (Figure 3.8). The two largest flocks (236 individuals in total) comprised over half the ducks seen. These two flocks were seen on 31 August and 25 September and resulted in high levels of recorded duck migration on those two days (Figure 3.9). Those two days were also days of peak goose migration. These two large flocks were flying east (170 ducks) and south (66 ducks) and both were at the highest altitudes recorded for duck flocks (170 ducks at 150 m and 66 ducks at 500 m).

Both of the large flocks of ducks were seen during a morning watch and contributed to the much larger number of ducks seen in the morning than in the evening (Table 3.8, Figure 3.10). More flocks were seen in the evening than in the morning but this difference was not significant (Wilcoxon matched-pairs signed-ranks, $T = 87$, $N = 20$, $P>>0.05$). Elsewhere, large numbers of ducks take off around sunrise and around sunset. Ducks that took off from the Peace-Athabasca Delta near sunrise were presumably largely responsible for the peak 1-2 h after sunrise (Figure 3.10). Those that took off from the delta at sunset would have passed over the study area too late in the evening to be detected.

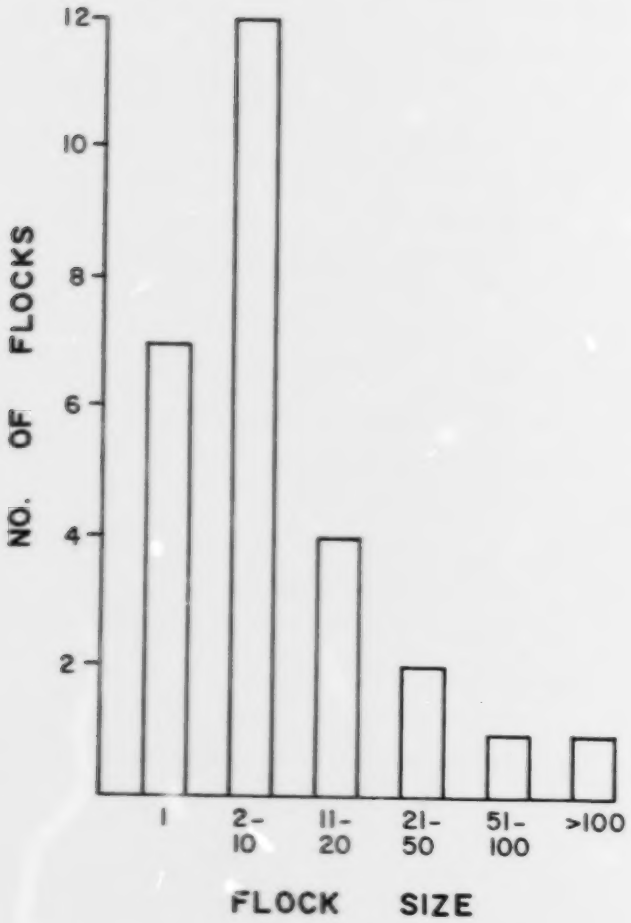

Figure 3.8. Distribution of flock sizes of ducks seen during migration watches.

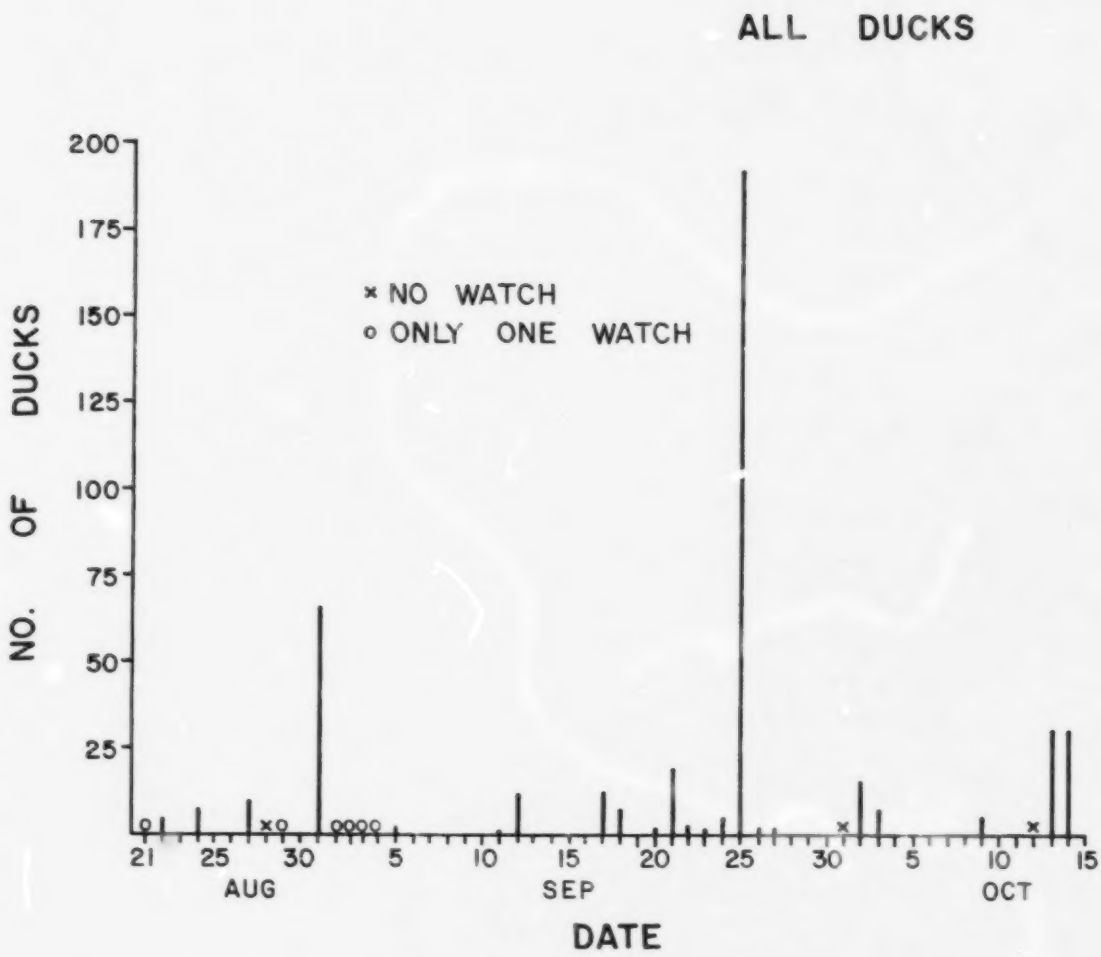

Figure 3.9. Daily volume of movement of ducks past the migration watch post.

Table 3.8. Numbers of ducks seen during migration watches in the study area, 21 August-15 October 1984.

	Morning				Evening			
	Before SR[a]	SR to SR + 1	SR + 1 to SR + 2	Total	SS - 2 to SS - 1	SS - 1 to SS	After SS	Total
No. ducks	40	81	171	292	57	45	46	148
No. flocks	7	4	2	13	6	6	8	20
Ducks/h	1.6	1.7	3.6	2.4[b]	1.1	0.9	1.5	1.1[b]

[a] SR = sunrise, SS = sunset.
[b] Overall value for the morning or evening watch.

Many of the smaller flocks of ducks were flying at low altitudes and in a variety of directions (see Figures 3.11 and 3.12, but note that the two large flocks are included in these data). Some of these ducks may have been engaged in local movements. For example, the apparently moderate movement on 21 September (Figure 3.9) was entirely to the north or northwest. Moderate numbers of ducks did, however, move south on 13-14 October. This movement coincided with the beginning of a major winter storm. Although birds in general, including ducks, tend to avoid migration during snowfalls (Richardson 1978), Bellrose (1974) reported that some autumn flights do occur during snow. Richardson (1978) suggested that the selective advantage of departure ahead of severe weather may sometimes outweigh the dangers of flying in snowstorms.

Many more ducks were seen during migration watches in 1975 (10.3/h) (Ward et al. 1976) than in 1984 (1.7/h). The reasons for this are unclear. Numbers of ducks on waterbodies in the study area in late summer and autumn were approximately equal in the two years (McLaren and Smith 1985). In addition, drought conditions on the prairies in 1984 (cf. McLaren and Smith 1985) may well have resulted in larger numbers on the Peace-Athabasca Delta and, presumably, larger numbers of transients through the study area in

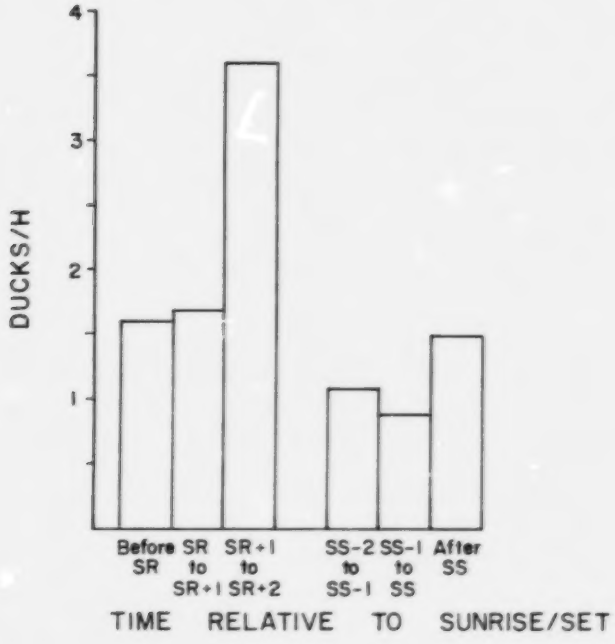

Figure 3.10. Volume of movement of ducks at various times of day (relative to sunrise and sunset).

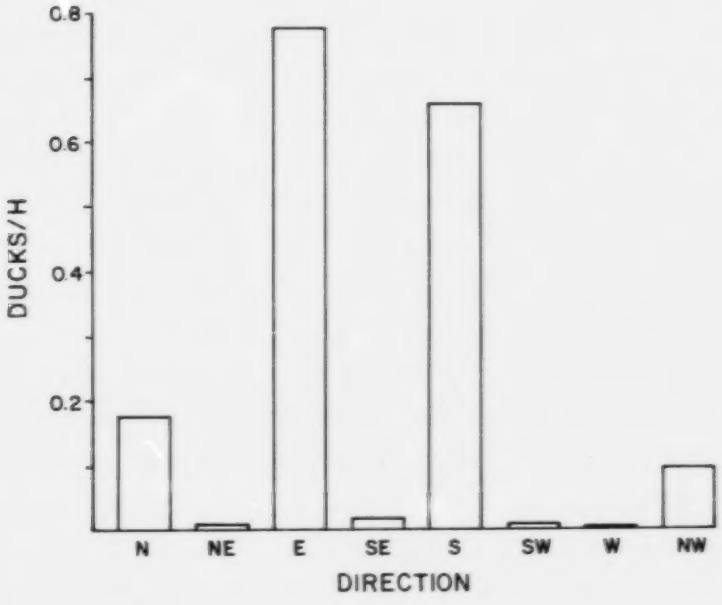

Figure 3.11. Volume of movement in each direction of ducks recorded during migration watches.

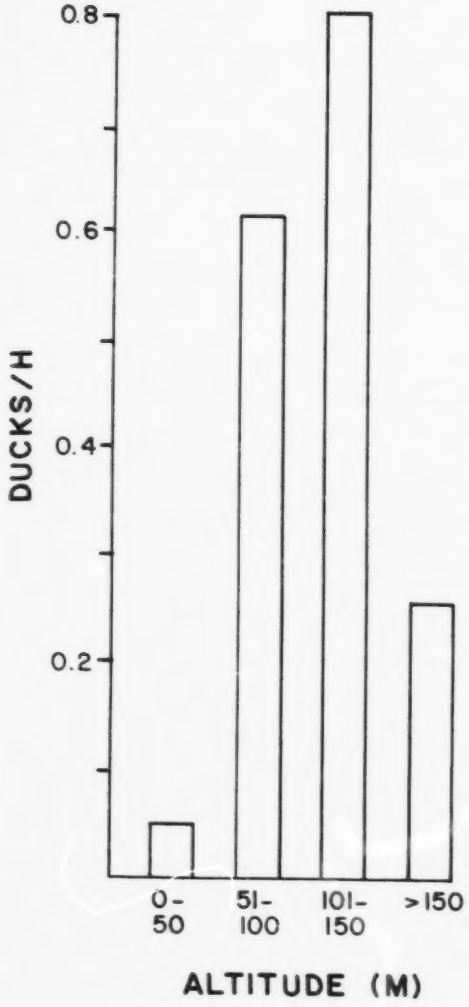

Figure 3.12. Altitudinal distribution of ducks recorded during migration watches.

1984. However, even though numbers seen during the two years were very different, the migration patterns tended to be similar. In both years, numbers of ducks seen during watches tended to be highest on the same days that goose migration was highest.

3.3.1 Ducks on Horseshoe Lake

As an additional indicator of duck migration, the numbers of ducks on the portion of the north end of Horseshoe Lake visible from the migration watch blind were counted. Counts were made twice daily, once during the morning watch and once during the evening watch. Occasionally, counts could not be made because Horseshoe Lake was obscured by rain or fog. Altogether, counts were made on 42 mornings and 48 evenings. Figure 3.13 shows three-day averages for the morning and evening counts.

Numbers of ducks on Horseshoe Lake fluctuated considerably during the study, but tended to be higher in late September and early October than in late August and early September. Numbers seen during the evening watch in particular tended to be higher later in the study. The consistently lower morning values suggest that ducks may have been gathering on Horseshoe Lake during the day prior to departing southward overnight. The observations of flocks of scaup (Aythya spp.) on Horseshoe Lake in September and October (McLaren and Smith 1985) also suggest that the lake was being used as a temporary staging area. Scaup are diving ducks that are unlikely to spend long periods on a lake as shallow as Horseshoe Lake. The abrupt decrease in numbers on 15 October probably resulted from the departure of many ducks ahead of the winter storm that began on 13 October and intensified on 14 and 15 October.

3.4 Raptors

A total of 26 raptors were recorded during migration watches. This total included three sharp-shinned hawks, four red-tailed hawks, one rough-legged hawk, four harriers, four unidentified hawks, four bald eagles, two golden eagles and four kestrels. There was no evidence of any concentrated migration of raptors over the study area.

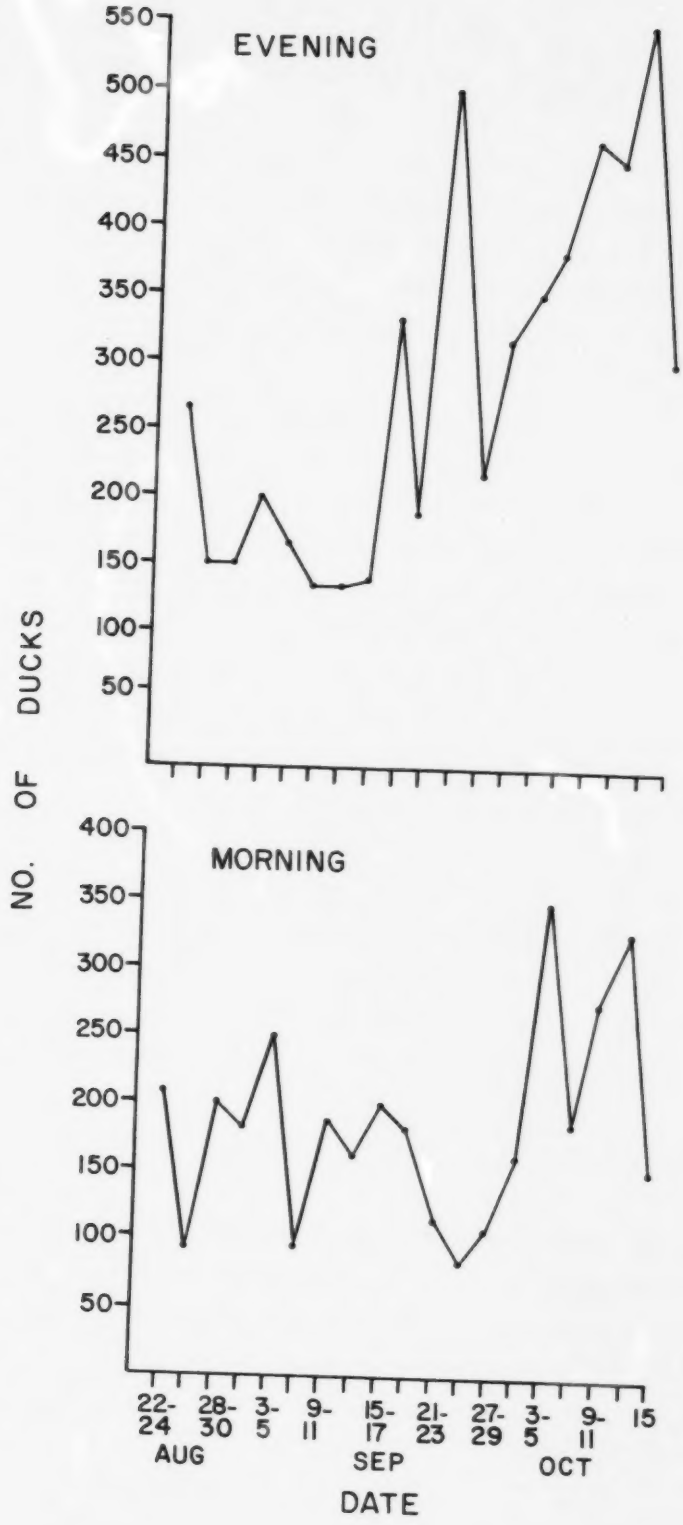

Figure 3.13. Numbers of ducks recorded on Horseshoe Lake in the morning and evening (three-day averages).

3.4.1 Bald Eagle (Haliaeetus leucocephalus)

Bald eagles nest throughout northeastern Alberta and the southern Northwest Territories (Salt and Salt 1976). Four bald eagles were recorded during migration watches. These sightings probably represent repeated observations of one or both of the pair of bald eagles that nested on Saline Lake (McLaren and Smith 1985). The eagles that were seen were soaring at altitudes between 60 m and 180 m.

3.4.2 Northern Harrier (Circus cyaneus)

Harriers are fairly common summer residents of Alberta; most leave by November (Salt and Salt 1976). Four harriers were seen during migration watches. Two were moving south on 29 August. Two sightings (possibly the same bird) were made on 21 September; one was moving south and one north. All harriers were between 60 and 80 m above the Athabasca River.

3.4.3 Sharp-shinned Hawk (Accipiter striatus)

Sharp-shinned hawks are summer residents of northern Alberta, and it is unlikely that any of the three sightings during migration watches were of actively migrating hawks. One was seen chasing a kestrel, one was hunting a few metres from the ground, and one was descending to land in a tree. These three sightings may well have been all of the same individual.

3.4.4. Red-tailed Hawk (Buteo jamaicensis)

Red-tailed hawks are common summer residents of northern Alberta and most leave by early October (Salt and Salt 1976). The four red-tailed hawks recorded in this study may well have been repeat observations of the same individual. All sightings occurred between 6 and 19 September and directions of movement varied from north through south.

3.4.5 Rough-legged Hawk (Buteo lagopus)

Rough-legged hawks do not nest in northern Alberta but pass through during migration. The main period of southward migration is October and November (Salt and Salt 1976). During the migration watches one individual was seen on 22 September. It was circling southwards and was probably an early migrant.

3.4.6 Golden Eagle (Aquila chrysaetos)

Golden eagles are uncommon permanent residents in northern Alberta, but some individuals may move south during the winter (Salt and Salt 1976). Two golden eagles, both recorded on 4 October, were seen during migration watches. Both were immature individuals and they were gliding south-southwestwards at an altitude of 80 m.

3.4.7 American Kestrel (Falco sparverius)

American kestrels are fairly common summer residents of northern Alberta but most leave during the first two weeks of September (Salt and Salt 1976). Four kestrels were seen during migration watches. Three of these (two on 6 September and one on 19 September) were moving south or southwest and may have been migrating. The fourth was being chased, close to the ground, by a sharp-shinned hawk.

3.5 Sandhill Crane (Grus canadensis)

A total of 21 sandhill cranes in two flocks were seen during migration watches; 132 sandhill cranes in eight flocks were seen during off-watch hours. In addition to the flocks that were seen, three flocks were detected only by sound during migration watches. The numbers of birds in these flocks are unknown. All sandhill cranes were seen or heard between 23 August and 18 September 1984 (Table 3.9).

Table 3.9. Characteristics of sandhill crane flocks observed passing over the study area, 21 August-15 October 1984.

	No. of Birds	On or Off Watch	Flight Direction	Altitude (m)
23 August	18	on	WNW	90
26 August	24	off	S	200
27 August	6	off	S	60
	8	off	S	60
29 August	3	on	S	90
6 September	2	off	-[a]	-
	15	off	S	150
11 September	+[b]	off	SW	-
12 September	18	off	SE	70
14 September	+	on	-	-
	+	on	W	-
15 September	17	off	SE	30
16 September	+	on	-	-
18 September	42	off	S	75

[a] Unknown.
[b] Cranes were heard flying over but could not be seen.

Of the sandhill cranes seen during migration watches, a flock of three was flying south and a flock of 18 birds was flying west-northwest. Both flocks were about 90 m above the Athabasca River. All of the cranes seen during off-watch hours were flying to the southeast, south or southwest.

Sandhill cranes nested in the study area in 1975 (Sharp and Richardson 1976) but no nesting cranes were found in 1984. Neither were transients seen during waterbody surveys in late summer and fall 1984 (McLaren and Smith 1985). The timing of sandhill crane migration was similar in 1975 and 1984. In 1975, migration was underway by mid August and the last cranes were seen on 15 September (Ward et al. 1976). In 1984, migrating cranes were seen soon after the start of migration watches on 21 August and the last cranes were seen on 18 September.

3.6 Gulls

Four species of gulls occur regularly in the study area. These are the ring-billed gull (Larus delawarensis), herring gull (L. argentatus), California gull (L. californicus) and Bonaparte's gull (L. philadelphia). All four species nest in northeastern Alberta. California gulls leave Alberta by mid September but Bonaparte's, herring and ring-billed gulls remain into October (Salt and Salt 1976). No Bonaparte's gulls were seen during migration watches. The other three species are very similar in plumage and, although ring-billed gulls are smaller than the other two species, flying birds cannot be identified by size unless a direct comparison can be made. Because of this, these three species of gulls are discussed together.

A total of 6137 gulls (24.3/h) were observed; 222 gulls (3.6%) were identified as herring gulls and 45 (0.7%) were identified as ring-billed gulls. The remainder were not identified to species. Many gulls were seen as single individuals but flocks as large as 200 birds were also seen (Figure 3.14).

The large majority of the gulls that were recorded were not migrating. Rather, they were making local flights to or from a roost on Mildred Lake. When gulls began using Mildred Lake as a roost is unknown; the first local flight recorded was a flock of 16 gulls flying west-northwest toward the lake on the evening of 6 September. The following morning, 20 gulls were seen on a return southeastward path. However, it was not until 14 September that moderate to large numbers of gulls were seen flying to or from the roost regularly (Figure 3.15). The roost was found at the northwest end of Mildred Lake in early October and, based on the largest evening count, was used by at least 617 gulls.

The gulls flying to Mildred Lake roost were coming from day use areas to the south. They quite probably followed the Athabasca River northwards before turning away from the river toward Mildred Lake. The precise route followed by the gulls appeared to be somewhat variable from night to night and the migration watch post was apparently near the eastern edge of the

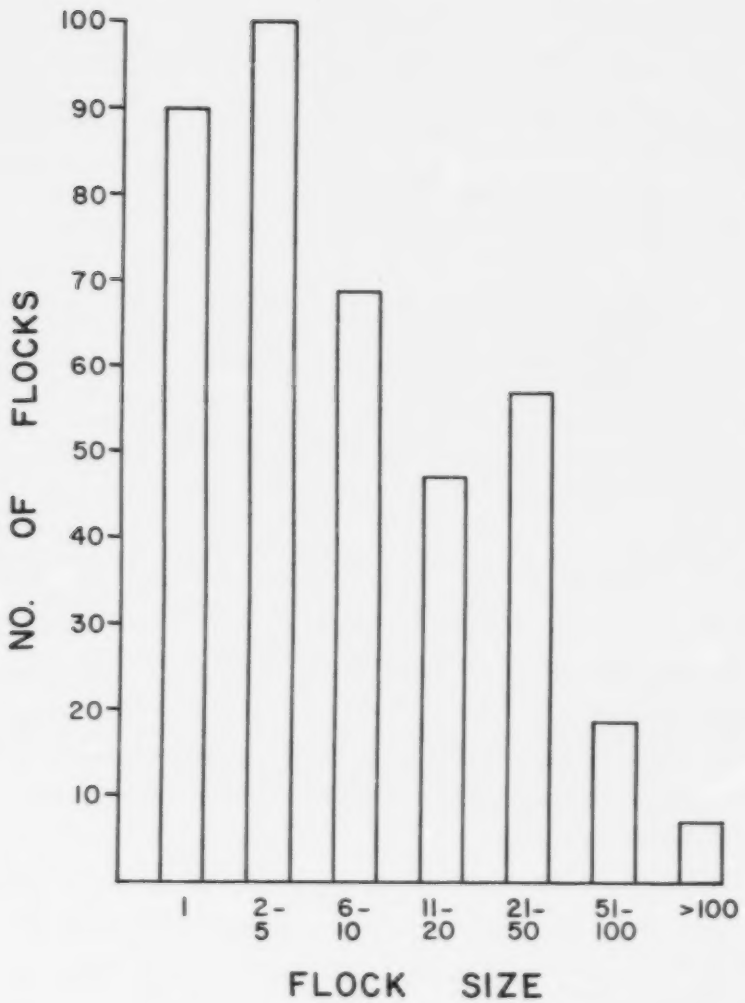

Figure 3.14. Distribution of flock sizes of gulls seen during migration watches.

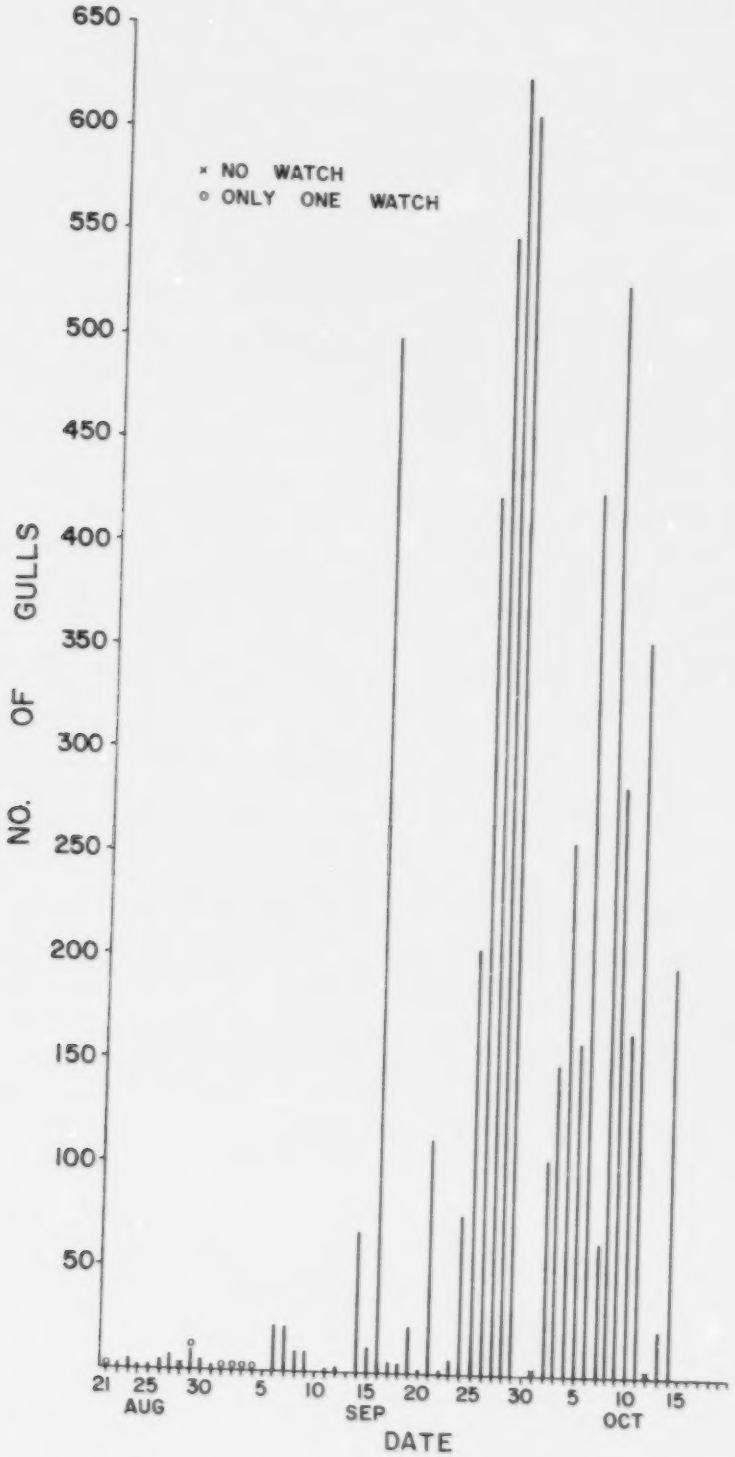

Figure 3.15. Daily volume of movement of gulls past the migration watch post.

corridor between the river and Mildred Lake. Over 40% (109 of 267 sightings) of the flocks seen going in the general direction of Mildred Lake (i.e. west through northwest) passed directly over the blind. Gulls flying between the river and Mildred Lake in the western portion of this corridor would not have been seen during watches because of the trees to the west of the blind. Slight variations in route from night to night could account for the variability in numbers seen each day (Figure 3.15). Gulls travelling to the roost did so mostly in the hour before sunset and from sunset until dark (Figure 3.16).

Gulls that were detected leaving the roost in the morning were mainly travelling southeast (Figure 3.17) but far fewer gulls were seen in the morning than in the evening (Table 3.10). Gulls also flew higher in the morning than in the evening (χ^2 = 3365.0, df = 6, $P<0.001$) (Figure 3.18). Why this should be so is unknown but possibly higher altitudes allow the gulls to see farther during their search for food sources. In the evening, of course, gulls were flying to one known location.

It is difficult to compare numbers of gulls seen in 1975 with those in 1984 because it is not known with certainty which gulls in 1984 were not involved in roost flights. However, if it is assumed that only gulls flying west through northwest in the evening and east through southeast in the morning were involved in roost flights, then 223 gulls that were not involved in roost flights were recorded in 1984. In 1975, small numbers of gulls were seen almost daily with a total of 293 birds seen from 21 August to 15 October (Ward et al. 1976). However, in 1975 as well as in 1984 most gulls were seen just before or after sunset and were probably going to roost. There was no evidence that Mildred Lake was used as a roost in 1975.

3.7 Common Raven (Corvus corax)

Ravens are permanent residents in northern Alberta but some individuals do move southward in winter (Salt and Salt 1976). In this study, 87 ravens (0.3/h) were detected during migration watches, 17 (19.5%) of which were heard but not seen. Most ravens were seen as single individuals but 14 flocks of two birds and two flocks of three birds were also seen. There was

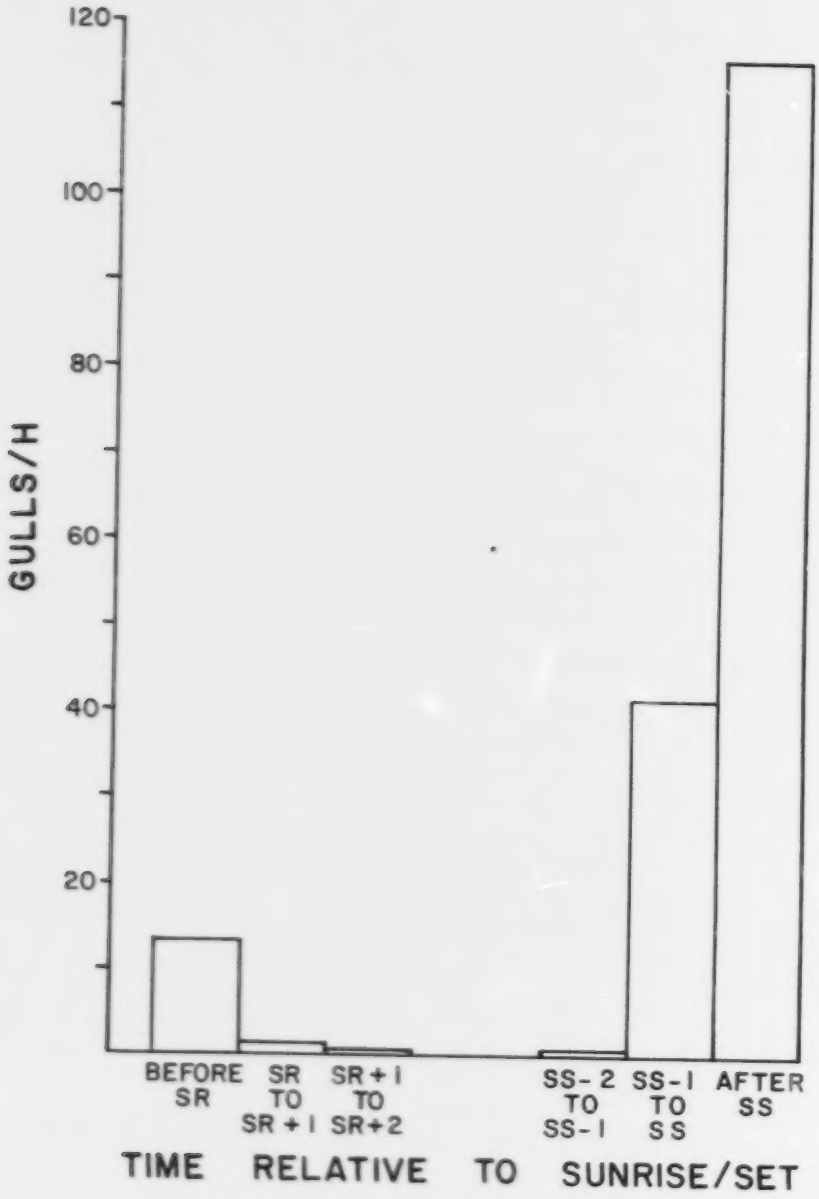

Figure 3.16. Volume of movement of gulls at various times of day (relative to sunrise and sunset).

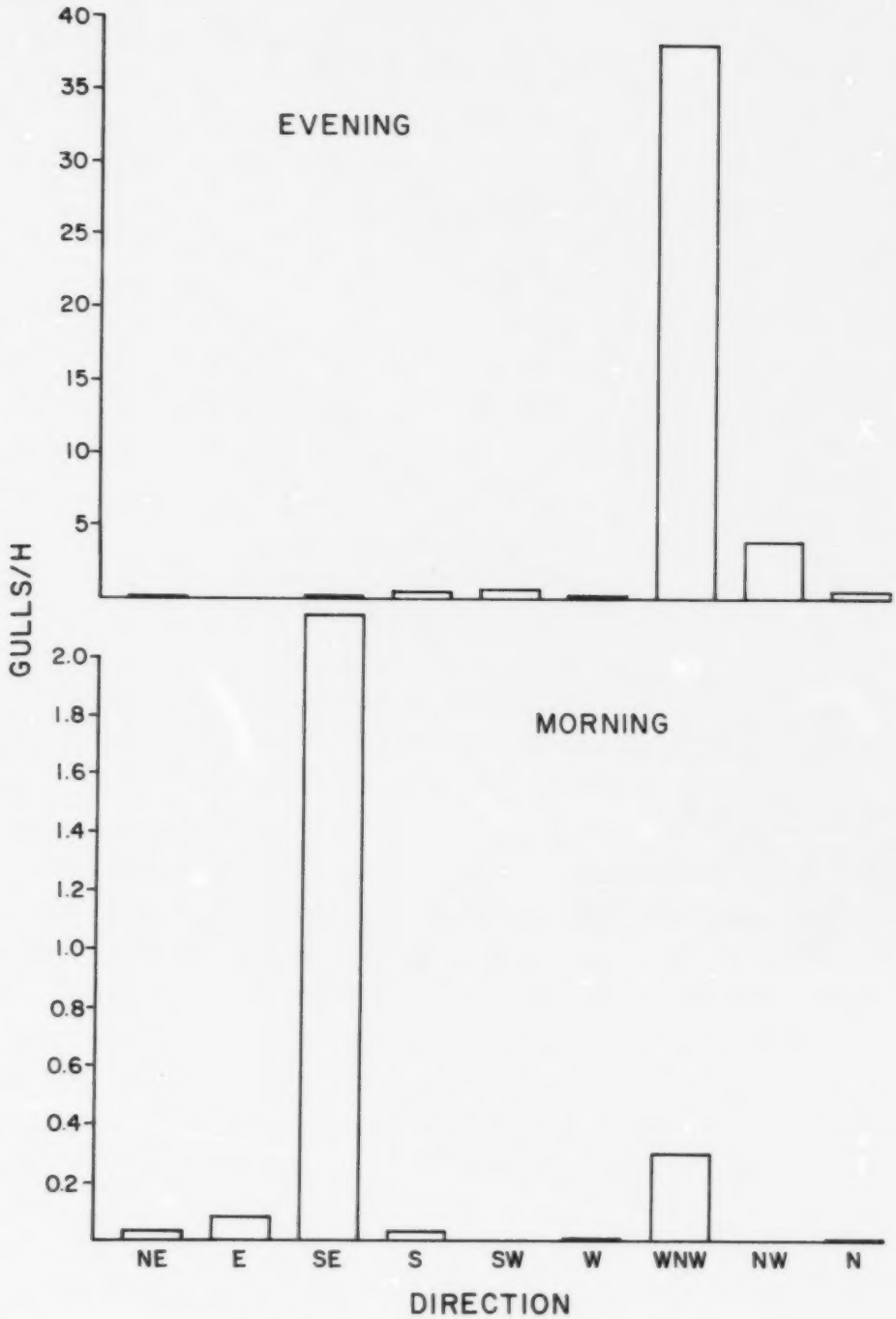

Figure 3.17. Volume of movement in each direction of gulls during morning and evening migration watches.

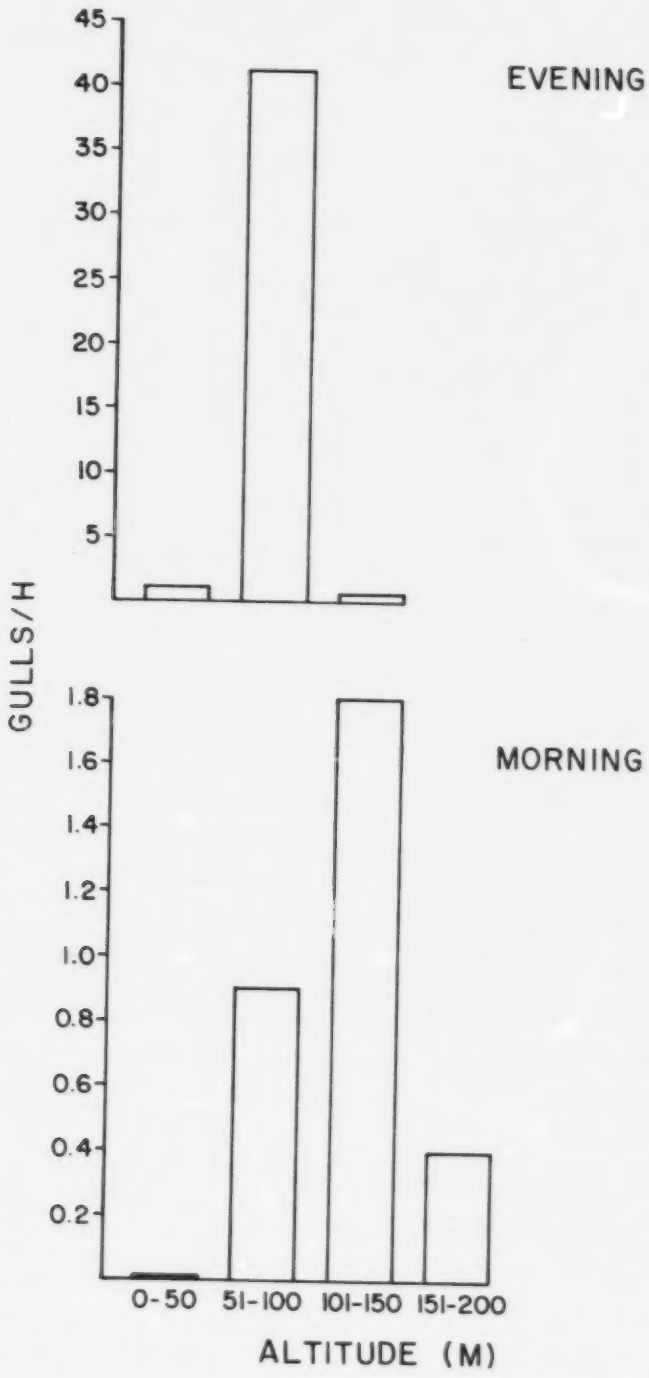

Figure 3.18. Altitudinal distribution of gulls recorded during morning and evening migration watches.

Table 3.10. Numbers of gulls seen during migration watches in the study area, 21 August-15 October 1984.

	Morning				Evening			
	Before SR[a]	SR to SR + 1	SR + 1 to SR + 2	Total	SS - 2 to SS - 1	SS - 1 to SS	After SS	Total
No. gulls	317	44	19	380	27	2247	3483	5757
No. flocks	18	20	13	51	14	151	173	338
Gulls/h	12.7	0.9	0.4	3.1[b]	0.5	44.0	115.6	43.7[b]

[a] SR = sunrise, SS = sunset.
[b] Overall value for the morning or evening watch.

no tendency for larger flocks to occur later in the season, as might be expected if birds were migrating. There was, however, some indication that larger numbers were present in October than earlier in the study. In August and September, 41 ravens (0.2/h) were seen but, in October, 46 (0.7/h) were seen.

More individuals and more flocks of ravens were seen in the morning than in the evening (Table 3.11). However, most ravens appeared to be flying during the day, since the largest numbers were seen in the periods more than one hour after sunrise or before sunset.

Ravens were seen flying in all directions except northeast (Figure 3.19). However, the largest proportion were flying south or southwest; this suggests that at least some migration was occurring. Almost all the ravens seen (90.8%) were flying between 51 and 100 m above the elevation of the Athabasca River (Figure 3.20).

In 1975, as in 1984, numbers of ravens increased in October. This suggests that there was some movement into the study area in October. A much larger number of ravens (1092) was seen during migration watches from 21

Table 3.11. Numbers of ravens seen during migration watches in the study area, 21 August-15 October 1984.

	Morning				Evening			
	Before SR[a]	SR to SR + 1	SR + 1 to SR + 2	Total	SS - 2 to SS - 1	SS - 1 to SS	After SS	Total
No. ravens	2	30	19	51	26	9	1	36
No. flocks	2	24	16	42	20	6	1	27
ravens/h	0.1	0.6	0.3	0.4[b]	0.5	0.2	<0.1	0.3[b]

[a] SR = sunrise, SS = sunset.
[b] Overall value for the morning or evening watch.

August to 15 October 1975 than during the 1984 study (87). Many of the 1975 records probably represent repeated sightings of the same individuals, but over 150 birds were present in the study area in late October of that year (Ward et al. 1976). Ward et al. (1976) speculated that ravens were congregating in the study area in order to take advantage of the availability of food at refuse dumps. However, changes in refuse handling practices, at least by Syncrude, had occurred by 1984, with the result that far less food was available to ravens on Lease 17 in 1984 than in 1975. We have no information about the refuse handling procedures of the other operator in the area, but a change in its refuse handling practices or in refuse dumping locations could easily have affected numbers of ravens seen during 1984 migration watches.

3.8 Other Species

This section presents an annotated list of the smaller species of birds that were observed either during migration watches or near the AOSERP camp in 1984. Dates of last observation are given where appropriate. However, these dates should be considered only as a general indication of departure times since we did not search for small birds regularly. Comments regarding the

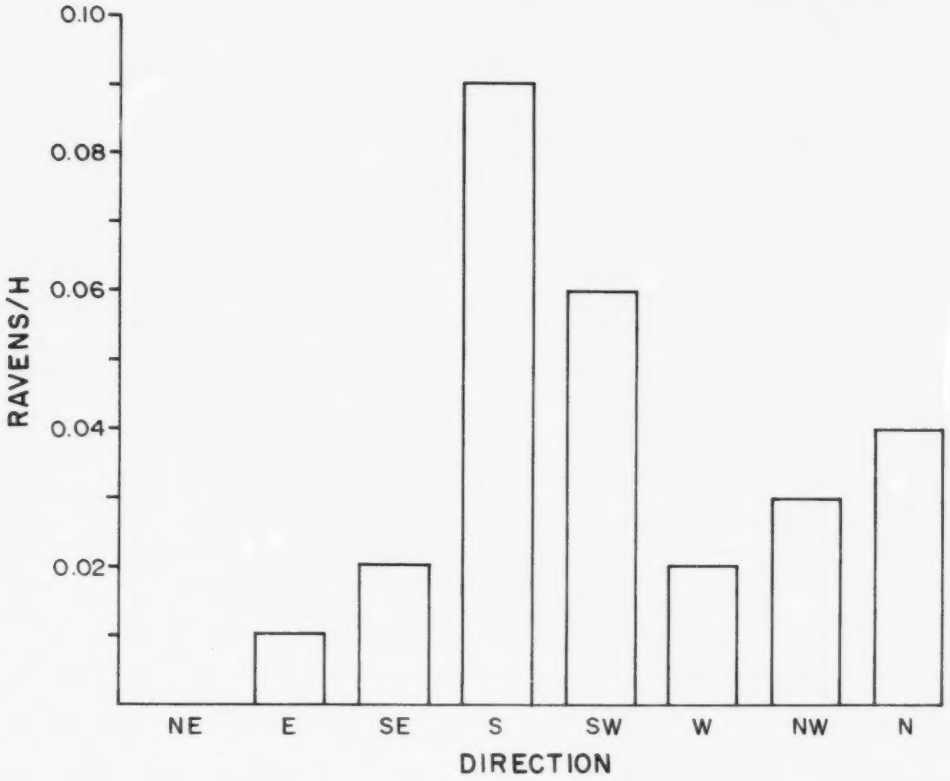

Figure 3.19. Volume of movement in each direction of ravens seen during migration watches.

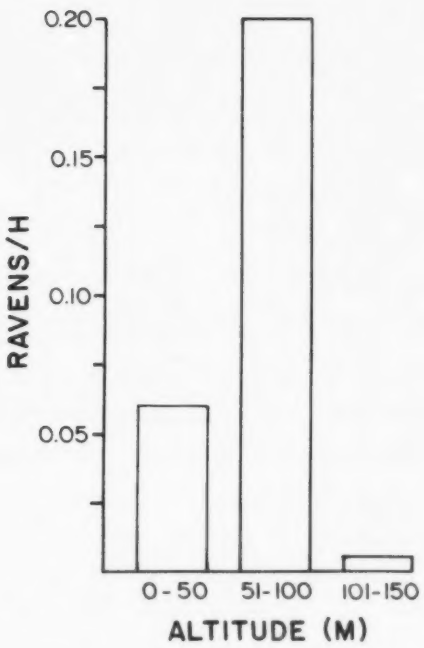

Figure 3.20. Altitudinal distribution of ravens recorded during migration watches.

status of these species in Alberta are all based on Salt and Salt (1976) unless otherwise noted.

Yellowlegs spp. (Tringa flavipes and T. melanoleuca).--Common summer resident. Heard occasionally until 19 September but present in the study area until at least 9 October (McLaren and Smith 1985).

Common Snipe (Gallinago gallinago).--Common summer resident. Seen or heard occasionally until 12 September during migration watches but present in the study area until at least 29 September (McLaren and Smith 1985).

Common Nighthawk (Chordeiles minor).--Local summer resident. Seen regularly during this study until 6 September. Most had probably departed by this date.

Yellow-bellied Sapsucker (Sphyrapicus varius).--Common summer resident. Last seen on 13 September during this study.

Hairy Woodpecker (Dendrocopus villosus).--Fairly common permanent resident. Seen regularly until the end of the study.

Black-backed Woodpecker (Picoides arcticus). Uncommon permanent resident. Seen only once, on 30 September, during this study.

Common Flicker (Colaptes auratus).—Common summer resident. Seen or heard regularly during this study until 26 September and last seen on 5 October.

Pileated Woodpecker (Dryocopus pileatus).--Uncommon permanent resident. Seen during migration watches.

Bank Swallow (Riparia riparia).--Common summer resident. During this study, the last one was seen on 30 August. In 1975, swallows were last seen on 7 September (Ward et al. 1976).

Gray Jay (Perisoreus canadensis).—Common permanent resident. Seen regularly in flocks of up to five individuals until the end of the study.

Blue Jay (Cyanocitta cristata).--Summer resident, less common winter resident. Seen regularly during this study until 25 September.

Black-billed Magpie (Pica pica).--Scarce permanent resident. One seen during this study on 20 September.

Black-capped Chickadee (Parus atricapillus).--Common permanent resident. Seen regularly until the end of the study.

Boreal Chickadee (Parus hudsonicus).--Fairly common permanent resident. Seen regularly until the end of the study.

Red-breasted Nuthatch (Sitta canadensis).--Fairly common summer resident. Scarce, local winter resident. Seen regularly until 23 September. Last seen during this study on 9 October.

Ruby-crowned Kinglet (Regulus calendula).--Common summer resident. Last seen during this study on 23 September.

American Robin (Turdus migratorius).—Common summer resident. Last seen during this study on 9 October and in 1975 on 12 October (Ward et al. 1976).

Cedar Waxwing (Bombycilla cedrorum).--Summer resident. During this study the last one was seen on 6 September. In 1975, this species was last seen on 1 September (Ward et al. 1976).

Northern Shrike (Lanius excubitor).--Transient. One seen during this study on 8 October.

Yellow-rumped Warbler (Dendroica coronata).—Common summer resident. During this study the last one was seen on 23 September.

Palm Warbler (Dendroica palmarum).—Common summer resident. During this study the last one was seen on 14 September but the species was probably present later.

American Tree Sparrow (Spizella arborea).--Abundant transient. During this study the last one was recorded on 30 September but the species was probably present until mid October (cf. Salt and Salt 1976).

Fox Sparrow (Passerella iliaca).--Local summer resident. Seen in 1984 only as a transient on 23 September.

Swamp Sparrow (Melospiza georgiana).--Summer resident. During this study the last one was seen on 30 September.

White-throated Sparrow (Zonotrichia albicollis).--Common summer resident. During this study the last one was seen on 30 September.

Dark-eyed Junco (Junco hyemalis).--Common summer resident. During this study the last one was seen on 30 September but the species was probably present until late October (cf. Salt and Salt 1976).

Lapland Longspur (Calcarius lapponicus).--Common transient. Flocks of 15 to 50 birds were seen between 6 and 18 September 1984.

Snow Bunting (Plectrophenax nivalis).—Common winter resident that migrates to the study area from arctic nesting areas. First seen on 6 October in 1975 (Ward et al. 1976) and on 6 October in 1984.

Red-winged Blackbird (Agelaius phoeniceus).—Common summer resident. Last seen on 31 August during this study and on 8 September in 1975 (Ward et al. 1976).

Pine Siskin (Carduelis pinus).—Fairly common local summer resident and transient in northern Alberta. Small numbers were present from at least 20 September to 10 October 1984. Larger numbers (several flocks of 15 to 200 birds daily) were present from 11 October until the end of the study. Most flocks seen were flying southwards.

Evening Grosbeak (Coccothraustes vespertinus).--Scarce summer resident. One seen on 10 September.

Redpolls (Carduelis flammea and C. hornemanni).--Common winter residents. During this study, redpolls were first seen on 14 October but they were seen as early as 18 September in 1975 (Ward et al. 1976).

4.0 DISCUSSION

This study was designed to provide an index of autumn diurnal migration across the Crown Lease 17 area. The index was provided through counts of birds flying in and over the Athabasca River valley at the eastern edge of the lease. This location was chosen because the height of the land at the top of the valley enabled observers to see for a substantial distance and because the river itself, trending north-south, probably concentrates migrating birds. For birds that do tend to concentrate along the river, the estimates of migration volume during this study will be somewhat higher than would be obtained at sites farther from the river. For example, Ward et al. (1976) used two migration posts in 1975, one overlooking the Athabasca River valley and one about 10 km west of the river. During fall migration Ward et al. (1976) recorded 12.7 geese/h and 10.3 ducks/h flying past the eastern post above the Athabasca River. However, rates of migration 10 km west of the river were only 6.3 geese/h and 2.2 ducks/h detected flying past the western post. The proportion of migrating waterbirds that follow the river is not known. However, it is apparent that many birds do fly outside of the river valley, as evidenced both by the counts from the western post in 1975 and also by the large numbers of geese seen flying over the AOSERP camp and the Syncrude mine and plant areas during off-watch hours. On balance, it is probable that the better visibility from the height of land above the river, combined with the advantage in analysis of a potentially larger sample size, would overcome the disadvantage of a possibly inflated value for volume of migration relative to that elsewhere in the area. In addition, even if the total volume of migration is inflated somewhat, this does not affect the ability to discern day-to-day changes in volume of migration.

During this study, a number of species that commonly occur on the waterbodies in the study area were not seen at all during migration watches. These include the common loon (Gavia immer), grebes (Podiceps spp.) and the American coot (Fulica americana). Loons were seen uncommonly during the waterbody surveys (maximum of 16 during the 26-30 August survey, McLaren and Smith 1985) and it is not surprising that none were seen during migration watches. Grebes were fairly common and coots were abundant during the late summer and fall waterbody surveys (McLaren and Smith 1985). However, both grebes and coots are nocturnal migrants (Sooter 1941; Palmer 1962) and, thus, would not have been seen during the diurnal migration watches.

The volume of migration of all species on any given day depends on a number of factors, including weather conditions, season, and numbers of birds available to migrate. Different species migrate at different times within a migration period. Southward migration of shorebirds, for example, begins as early as July. Some shorebirds were still migrating through the study area in late September but the peak of shorebird migration occurred in early to mid August, before migration watches began (McLaren and Smith 1985). Thus, the low numbers of shorebirds recorded during this study are not an indication of the importance of the study area to migrating shorebirds. The migration watches were intended primarily to document migration of the larger waterbirds (swans, geese, ducks, cranes, gulls), and the study period covered the period of peak migration by most of these groups. However, even within the two month study period, seasonality affected numbers of migrating birds. All sandhill cranes, for example, had apparently passed through by late September and none were observed after 18 September. Similarly, no geese were seen after 28 September. Gulls, on the other hand, were still present in the study area in substantial numbers in mid October and little evidence of migration was noted.

Numbers of birds available to migrate are affected both by the number that have already migrated and, in fall, by the success of the nesting season. Much larger numbers of young birds will be migrating after a successful nesting season than after an unsuccessful season. For example, Nieman and Dirschl (1973) reported numbers of staging waterfowl on the Peace-Athabasca Delta, to the north of the study area, in 1969 and 1970. In

1970, numbers of ducks were only 40% of the numbers present in 1969; numbers of geese and swans were 88% of those present in 1969. Unfortunately, there are no comparative figures for numbers of waterfowl staging on the delta in 1975 and 1984.

Weather conditions have a marked effect on the numbers of birds migrating. Weather affects birds at their staging areas, en route, and at their destinations. Cold, wet and, particularly, snowy weather at staging areas late in the fall may force birds to fly southwards in weather they would otherwise avoid (e.g., Bellrose and Sieh 1960; Bellrose 1974). However, in general, birds tend not to fly in precipitation but select favourable weather for migration. The precise weather variables that control volume of migration are difficult to determine because of the high degree of intercorrelation among the variables. However, multivariate statistical techniques are able to identify a small number of the most important variables. Most studies of fall migration have found that migration tends to occur with rising pressure, low or falling temperature, low humidity and following winds (Richardson 1978). These conditions tend to occur following the passage of a cold front. With following winds, some workers have found weak correlations with wind speed. For example, Blokpoel and Gauthier (1975) found that snow geese in spring departed from their North Dakota staging area with less than average speed tail winds. However, they found no significant correlation with wind speed by the time the geese passed over Winnipeg. In east-central Alberta, Richardson and Gunn (1971) found no correlation between wind speed and volume of migration even with opposing winds despite a large sample size.

In this study, only geese were seen in numbers sufficient to be reliably related to weather conditions. As discussed in Section 3.2.5, most geese were seen under the conditions when they would have been expected. Small peaks in the numbers of ducks observed also occurred following the passage of cold fronts on two occasions. Although only small numbers of sandhill cranes were observed, they too tended to be seen during the periods of high levels of goose migration. For example, two flocks were seen on 6 September, a day of heavy goose migration, and eight flocks were seen between 11 and 18 September, a period with moderate but steady levels of goose migration.

5.0 SUMMARY AND CONCLUSIONS

Large numbers of birds pass over the study area during autumn migration each year and some of these birds may land and rest in the area. The watches reported here could not detect many of these migrants either because they flew at night (e.g., most passerines) or because migration occurred primarily before or after the period during which watches were conducted. Some information was obtained about passerine migration based on observations of birds on the ground and these results have been briefly annotated. Most of the data, however, concerned medium and large- sized water-associated birds (swans, geese, ducks, gulls). These data complemented a study of birds using waterbodies in the study area in 1984 (McLaren and Smith 1985). That study documented use of waterbodies by both summer resident birds and birds using the waterbodies as migration stopover areas. The migration watch data also updated similar information collected in 1975 (Ward et al. 1976).

In both 1975 and 1984 most **tundra swans** passed over the study area primarily after the beginning of October. Few were seen on the ground in either year (Sharp and Richardson 1976; McLaren and Smith 1985). In both years, rather small numbers of swans were seen, suggesting either that most swans migrated by night (as is common elsewhere) or that most flew east or west of the study area, or both.

Geese comprised the largest group of migrants seen in this study area. **Canada geese** were by far the most abundant. **White-fronted geese** and **snow geese** also passed over the area in moderate numbers. Overall, an average of 24.3 geese/h were seen in 1984 vs. 17.3/h in 1975. Larger numbers were also seen during off-watch hours in 1984. However, in both years most geese passed directly over the area and few were seen on the ground (Sharp and Richardson 1976; McLaren and Smith 1985). Many passing geese probably followed the Athabasca River valley but a substantial number also migrated on a broader front. The peaks of goose migration in 1984 followed the passage of cold fronts through northeastern Alberta.

Rather small numbers of **ducks** were seen during daytime migration watches in 1984 as compared to 1975. Both surveys by McLaren and Smith (1985) and morning and evening counts of ducks on Horseshoe Lake during migration

watches indicated that substantial numbers of ducks used waterbodies on and near Lease 17 as stopover areas. The counts on Horseshoe Lake suggested that many ducks left by night, as is common elsewhere.

Sandhill cranes migrate over the study area in small numbers but few land. **Whooping cranes** have been recorded in the area in fall (Ward et al. 1976) but none were seen during this study.

Large numbers of **gulls** were seen in 1984 but few, and perhaps none, were migrating. Most were seen while they were flying to or from a roost site on Mildred Lake. A minimum of 617 gulls were using this roost in late September.

Comparison of data from migration watches in 1984 with data from 1975 (Ward et al. 1976) shows that patterns of migration over the study area have not changed appreciably. Timing of migration was similar for all species and species groups recorded in the two years and the diel pattern of passage was also similar. Although large numbers of geese and lesser numbers of tundra swans and sandhill cranes passed over in both years, few landed in the study area.

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7.0 Appendix 1. Daily totals of hours of migration watches.

Date	Hours of Watch			Date	Hours of Watch		
	Morning	Evening	Total		Morning	Evening	Total
21 Aug	0.00	2.73	2.73	18 Sep	2.52	2.65	5.17
22 Aug	2.67	2.47	5.14	19 Sep	2.47	2.68	5.15
23 Aug	2.43	2.75	5.18	20 Sep	2.50	2.58	5.08
24 Aug	2.53	2.63	5.16	21 Sep	2.50	2.73	5.23
25 Aug	2.55	2.48	5.03	22 Sep	2.48	2.62	5.10
26 Aug	2.52	2.55	5.07	23 Sep	2.60	2.50	5.10
27 Aug	2.53	2.42	4.95	24 Sep	2.57	2.80	5.37
28 Aug	0.00	0.00	0.00	25 Sep	2.62	2.83	5.45
29 Aug	0.00	2.35	2.35	26 Sep	2.53	2.75	5.28
30 Aug	2.47	2.38	4.85	27 Sep	2.58	2.73	5.31
31 Aug	2.52	2.52	5.04	28 Sep	2.67	2.75	5.42
1 Sep	2.55	0.00	2.55	29 Sep	2.62	2.72	5.34
2 Sep	2.50	0.00	2.50	30 Sep	2.60	2.00	4.60
3 Sep	0.00	2.65	2.65	1 Oct	0.00	0.00	0.00
4 Sep	0.00	2.53	2.53	2 Oct	2.47	2.68	5.15
5 Sep	2.50	2.48	4.98	3 Oct	2.67	2.58	5.25
6 Sep	2.37	2.45	4.82	4 Oct	2.37	2.63	5.00
7 Sep	2.48	2.48	4.96	5 Oct	2.57	2.67	5.24
8 Sep	2.52	2.00	4.52	6 Oct	2.43	2.63	5.06
9 Sep	2.30	2.33	4.63	7 Oct	2.55	2.60	5.15
10 Sep	2.50	2.62	5.12	8 Oct	2.42	2.67	5.09
11 Sep	2.45	2.75	5.20	9 Oct	2.45	2.68	5.13
12 Sep	2.48	2.63	5.11	10 Oct	2.40	2.55	4.95
13 Sep	2.10	2.58	4.68	11 Oct	2.43	2.46	4.89
14 Sep	1.33	2.72	4.05	12 Oct	0.00	0.00	0.00
15 Sep	2.67	2.77	5.44	13 Oct	2.43	2.33	4.76
16 Sep	2.62	2.63	5.25	14 Oct	2.47	2.37	4.84
17 Sep	2.57	2.77	5.34	15 Oct	2.33	2.50	4.83